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THE KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY.

EDITED BY

THEO. S. CASE.

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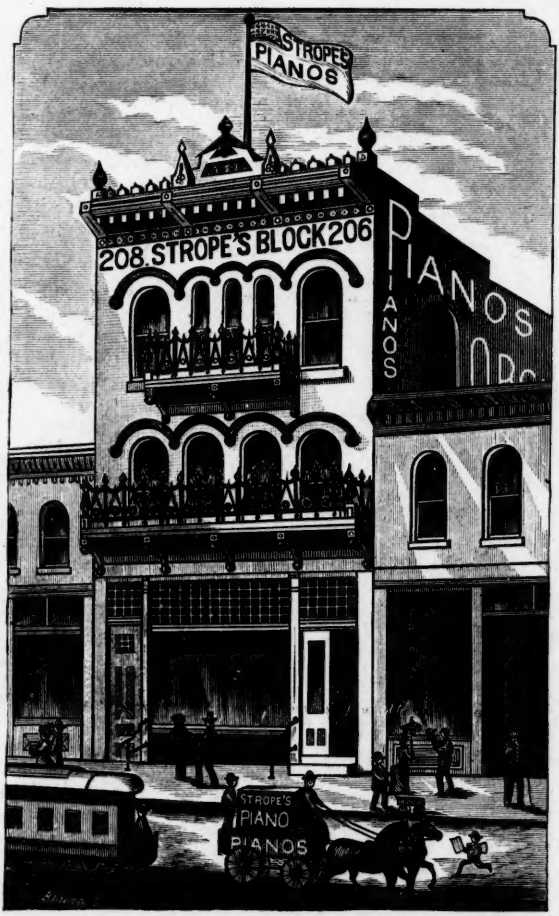

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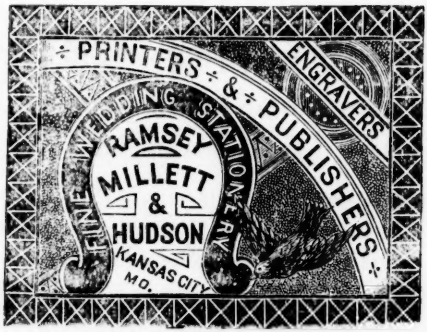

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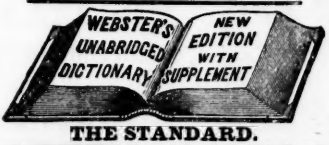

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REVIEW OF SCIENCE AND INDUSTRY,

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VOL. VII. APRIL, 1884. NO. 12

EDUCATION.

THE RELATIONS OF LAW AND MEDICINE.[1]

HON. S. O. THACHER.

The learned professions from immemorial time until a modern era included in three divisions the devotees of religion, medicine and law. Their fortunes have fluctuated with different epochs and exigencies and their relative values, significance and attainments have, by no means, been unvarying and persistent. Their domains have never been entirely distinct, but each has had much to do in regions familiar to one or both of the others. Yet, notwithstanding this communion of domicile, on the whole these pursuits of men have come on together with much forbearance and general good will.

It is quite true that every truth, natural or spiritual, must at the last be reconcilable with, support and fortify every other truth. The house cannot be divided against itself, and if one fact upturns another this last must be held to be a supposition, a mere spy and not a true man.

To disprove this harmony, of old the question was put by scholastic logicians, what would ensue were an irresistible force to meet an immovable body. Whichever way the answer came it was false. But suppositions like these do not affect the general statement that the solid irrevocable affirmations of religion, law and medicine, differing inasmuch as they apply to varying phases of life and

1. Delivered at the 15th Annual Commencement of the Kansas City Medical College, March 4, 1884.

matter, must have for each other the utmost accord. However wide the apparent gulf over it there is a bridge for the feet and between the most celestial truth and the most terrestrial there is a ladder whose golden rounds sustain the ever ascending and descending angels of recognition and friendship.

Something of this thought is in the words of Lorenzo to Shylock's Jessica,

> " There's not the smallest orb which thou behold'st
> But in his motion like an angel sings
> Still quiring to the young eyed cherubim:
> Such harmony is in immortal souls,
> But whilst this muddy vesture of decay
> Doth grossly close it in we cannot hear it.

Some of the old-time learning, confided to these professions in recent days, has passed into the keeping of other orders of proficient experts, and the acquirements of the teacher, the civil engineer and, more than all, of the fully panoplied editor, have either "molested the ancient solitary reign" of these pursuits or have given new force and direction to some parts of their original vocation.

The teacher of to-day is a far different person from the village schoolmaster of Goldsmith, and his field of action is covered with smoking batteries and rigid squadrons, the product of an age transcending in all great elements of progress any that has preceded it. The vast height and depth, the length and breadth of the curriculum of the most ordinary college of the land requires not one but many masters to unfold and impart. As we look in upon the higher circles of the teacher's life, the multitude and amplitude of his researches, in even one department of learning, suggests the mournful reflection of the old German professor of Greek, who, dying, bewailed that he had not given all his life to the dative case. Year after year we behold in our universities the division of chairs, the separating into different heads the investigation of what had before constituted a single line of instruction.

The complex character of the teacher's profession grows apace with its widening scope and importance. Not so distinct in its boundaries as the others, yet of immense importance and value is that profession whence comes the skill and wisdom to apply to the myriad uses of man the laws of nature, which tames the fiery spirits of the air and transforms into faithful and unwearying servants the blind unreasoning forces of the earth.

The profession which marks out the dimensions and mode of erecting a bridge over a turbid, violent river whereby one city shall become great and a dozen others well nigh ruined, which deals with iron lathes, gigantic trip-hammers and molten, metals until out of the commotion there comes into the tidal waters a ship that can cross the Atlantic Ocean in six days, lashed along its furious course by the fires of twenty-five hundred tons of coal, a profession that projects a path for the engine up and along dizzy precipices, through spiral tunnels in solid granite miles in length, which laughs at the efforts of the Pyrenees and the Mediterranean to stay the flight of the steam-horse and boldly takes up

the gauge of battle thrown down by mountains covered with eternal snows, and fills their hearts with more piercing shrieks and groans than fell from the lips of Enceladus writhing under Ætna; such a calling may well claim an entrance into the circle of those called learned. Of the power and extent of that intelligence that informs the press of to-day, one may repeat the words of Carlyle:

"Great governors, clad in purple, with fasces and insignia, are governed by their valets, by the poutings of their women and children; or, in constitutional countries, by the paragraphs of their able editors."

It is the "fourth estate" of the French revolution, and though an English journalist, in a recent address, somewhat combats this exalted idea of the puissance of this new power in human affairs, yet even Mr. Hatton yields his assent to this conclusion: "It is not to be denied that the press is absorbing more and more of the power which once belonged to parliament, and is becoming more and more potent in all decisions affecting public interest."

In our own country the widespread intelligence and the reading habits of the masses give to the press, not only in its sphere of proclaiming public opinion as it reports speeches, debates and current events, but in its reasoning, argument and philosophy, the power to create or direct the thoughts of men, of which Carlyle exclaims: "Ever louder rises the plaint of such a multitude; into a universal continual peal of what they call public opinion. What king or convention can withstand it?"

Without entering into any discussion of the extent of the accomplishments, the moral and intellectual brilliance and worth that should inspire the words of this ubiquitous teacher, we may well confess that a profession that can daily produce columns sparkling with humor, weighty with thoughts upon themes of transcendent practical utility, political economy and problems of commerce, revenue and home thrift, or serious with contemplations of those sublime and mysterious subjects whose beginnings are in the sunlight of the To-Day, but whose unfolding and certainty lie amid the mists and silences of the unknown To-Morrow, may well find a name among the vocations of men called learned. And if I am told that this list is still contracted, that there be many more pursuits whose technical knowledge, difficulty and beneficence entitle them to this old-time distinction, I make no denial, but incline to admit the virtue of their claim.

The true preacher, lawyer and doctor find no difficulty in admitting that there are many folds of that shepherd he calls learning, and none are more ready than they to admit that in the realms of practical discoveries, inventions, science, philosophy, and religion, the world is yet, as portrayed by the great Newton, gathering shells here and there among the sands, while the wide ocean lies yet unexplored.

Having thus briefly recognized the equal worth and position of all those who pursue different lines of moral or intellectual investigation and acquisition, I may be permitted and without disparaging any, to dwell for a few moments upon some of the relations that link together the legal and medical professions. The two

pursuits have many common lines of thought and history. On many sides and in many ways they glide into or overlap each other.

They emerge from the obscurity of civilizations long since extinct and they come into historic light with formulated systems, theories and principles, betokening research and discovery among people whose cities, temples and homes lie buried back and beyond authentic narrative or even reasonable conjecture.

The physicians of Homer were the sons of Esculapius, the fabled founder of the healing art, and the glimpses we catch of the knowledge of those dim eras, upon which, as yet, no light shines outside of that which flashes from the Iliad or Odyssey, show us advances in the line of organized medical knowledge far beyond the crude ideas of savage or barbarous tribes.

If it is probable that Schliemann has uncovered the site of the Ilium of ancient story, yet to what was sung by "the blind old bard of Scio's rocky isle," he has added nothing that throws into clearer effulgence the polity and wisdom of that distant day.

How settled and advanced were the laws and pursuits, the worship and learning of the nations that peopled the shores of the Archipelago in pre-historic times we still learn from those pages, whose pure refined diction indicate to us that back of Homer were ages of culture and civilization.

The side glances we there obtain of medicine reveal, to use the language of Dr. Payne, that "It already has a history." It was even then "a distinct and organized profession," and possessed a knowledge which must have come from long antecedent experience and observation. The antiquity of the profession doubtless exceeds that of any other. Its mutation and progress have been as marked as any. Who ever looks through the twentieth book of Pliny's Natural History, wherein he declares the medical properties of plants and the proper mode of extracting these virtues and particularly describes the diseases the decoction will cure, will easily see where the patent pill and lotion venders of today obtain so much knowledge. Some of these prescriptions read like an advertisement in a nineteenth century newspaper.

For the benefit of some men in great distress and whose "sands of life have almost run out," I give what the author says about the value of an herb he calls Porret. "The blades thereof stamped and laid to with honey healeth all sores and ulcers whatsoever, the biting of any venomous beast, the sting also of serpents are cured therewith." He commends it for deafness, "whistlings and crashing noises in the head." It will cure "headache, for which purpose," he says, "also it is good to poure into the eare when one goeth to bed and lieth to sleep two spoonfuls of the said juice and one of bonie." This medicine destroys pain in the back, hemorrhage of the lungs and consumption. Dropsy and jaundice flee from it and a "cataplasm of it cures green wounds." The author concludes, "finally it scoureth the pipes and cleareth the voice."

As Pliny gives the history of half a hundred other valuable plants equally rich in healing properties, it is a wonder anybody in his day ever thought of death. Through the flowing centuries the theories of medicine progressed with

many stoppages and fluctuations until the eighteenth century, when they appear to have gathered into a more unified, intelligible and powerful science.

However we may look upon the different schools and their comparative merits, one can readily assent to the catholic remark of Dr. Payne: "From a theoretical point of view, Hahnemann's is one of the abstract systems pretending to universality which modern medicine neither accepts nor finds it worth while to controvert. In the treatment of disease his practical innovations came at a fortunate time when the excesses of the depletory system had only partially been superseded by the equally injurious extreme of Brown's stimulant treatment. Hahnemann's use of mild, and often quite inert remedies contrasted favorably with both. Further he did good by insisting upon simplicity in prescribing when it was the custom to give a number of drugs, often heterogeneous and inconsistent, in the same prescription."

And yet we also agree that medicine in its largest sense, while claiming a source in an obscured past, and unfolded, amplified and augmented by the genius and labor of untold years, is yet looking to the future for its golden day. Already it is finding the sphere of prevention as wide and as important as that of cure. Before it lie the foes of human life encamped in noxious malaria, fetid sewers, lethal contagion and morbific habits of mind and body, and the tremendous play of spirit upon function and organic life upon the invisible and higher nature are problems for medicine some day to solve.

Into its horizon are drifting great truths and discoveries whose dimensions are only vague conjectures, as the curling smoke above the far away white caps tells the sailor that yonder goes some sort of steam-driven craft, but whether it is a pleasure yacht or the Great Eastern he cannot say. Magnetism, electricity, anesthetics, inoculation, imagination and volition, touching the body and giving it life or death; how wide is the undiscovered country?

The profession not only looks back to Hippocrates and Galen but forward to the day when, in the words of Sir J. Y. Simpson, as quoted in a brilliant article in an English magazine, physicians "shall be familiar with the chemistry of most diseases; when they shall know the exact organic poisons that produce them with all their exact antidotes and eliminations; when they shall look upon the cure of some maladies as simply a series of chemical problems and formulæ; when medical men shall be able to stay the ravages of tubercle, blot out fevers and inflammations, avert and melt down morbid growths, cure cancers, destroy all morbific organic growths and ferments, annul the deadly influence of malaria and contagions, and by these and various other means lengthen out the average duration of mean life."

The new shall transcend the old and the morning twilight brighten into the perfect day. And now if we inquire through what experiences and perturbation has the sister profession of the law come during these thousands of years that medicine has been evolving its present noble position, we are called to note the common history of both, save, as was to be expected the healing art had earlier uses and records.

The assuaging of human ills began before there were regulations for the preservation of the rights of property, the settlement of disputed questions of inheritance, the redress of grievances between men or settled institutions and laws. The very origin of legal principles lies back of all our research, and over this question our law writers differ even more than do our medical theorists over the beginnings of their art.

A sturdy Austrian writer, Dr. Rudolph Von Ihring, insists with intense vehemence that "all law in the world has been obtained by strife. Every principle of law which obtains had first to be wrung by force from those that denied it."

"The law is not mere theory, but living force. And hence it is that justice, which in one hand holds scales in which she weighs the right, carries in the other the sword with which she executes it. The sword without the scales is brute force; the scales without the sword is the impotence of law."

But there are other equally as acute reasoners who hold directly opposite views, one of whom, Savigny, is thus cited by Von Ihring:

"The earliest law has been, the world over, the law of custom.

"This law has neither been created nor sought for. It came into existence of itself, just as language came, and developed internally in the convictions of the people, externally in the order of life.

"The legislature is, so to speak, to the law of custom what the physician is to nature. Nature should help itself; the physician should interfere as seldom as possible, for his presence shows that the normal condition is disturbed and disease exists."

Ranged in antagonistic and imposing array, along this line of debate, are great names, as Hale, Blackstone and others, and their arguments seem entitled to equal weight. But law, like medicine, however unknown in its earliest eras, had its growth, its servitude and exaltation. If the thread of medical research carries us back through the laboratory of the alchemist seeking the fabled elixir of life, and the solvent that should turn iron into gold, or into the chamber of the astrologist finding some relation between the conjunction of planets and the lines of the hand or wrinkles of the brow, whereby the ever haunting mystery of the future may be made an open page, so does the legal clue into the past lead us by courts trying old women "for riding on broomsticks or giving cattle murrain," or where the settlement of a contested right was left to the doubtful result of a personal contest called "wager of battle," and the innocence or guilt of an accused person was solved by various ordeals of water or fire, as exposing him to drowning in cold water, scalding him with hot, or by his walking barefoot over heated plowshares. Nevertheless, all these past centuries have given something besides dross to the solid and well compacted bodies of law and medicine. And the same outlook we find to-day in the one we also see in the other.

Both have a more important and perhaps commanding duty in the present in warding off evil results than in rectifying them. In a graphic sentence Macaulay ascribes to the attention given by the Royal Society after the great plague of 1665, and the great fire of 1666, to the subject of sanitary police, "the changes which,

though far short of what the public welfare required, yet made a wide difference between the new and the old London, and probably put a final close to ravages of pestilence" in that country.

Very much of the serious and earnest labor of the lawyer of to-day is in so guiding the complex business of his clients, notably great mercantile establishments, companies and partnerships as to protect them from litigation and ensphere their rights in impregnable contracts and instruments. The law has its prophylactics as well as medicine. But not alone in these general features do these professions have analogies; they have always had intimate relations along that ever widening and extending territory we call medical jurisprudence.

Of course, I do not now allude to the help which now and then the lawyer renders to the doctor when a convalescent patient forgets to pay his bill, being in that regard under the influence or example of that important personage of whom the couplet runs:

"When the devil was sick the devil a monk would be,
When the devil was well the devil a monk was he."

Indeed there are quite a large number of persons in all commuities who do not look upon lawyers' fees or doctor's bills as a superlative means of grace. A sermon to such once in a while from the pulpit might do them good, at least it would give them the "benefit of the clergy." The growth, extent and variety of the questions which the student of medicine and the student of law must now master well illustrates and justifies the optimists' belief in the forward and upward struggle of the race.

The educated physician and the well read lawyer find the common problems of their callings increasing in number, complexity and refinement. The volumes on these questions yearly grow apace and fill ampler shelves in the library of the professions. In our day law and medicine are often deeply absorbed with investigations of cerebration. Human law, if not all law as applied to humanity, is pivoted upon the action and motive of beings capable of determining the boundaries of right and wrong and possessing the will to obey the one and reject the other.

The intimate yet veiled connection between the brain and the spirit, a relationship once so unknown that the presence of demoniacal agency was conjured up to account for actions which the science of to-day ascribes to a diseased sensorium, is ever presenting startling or tragic phases.

While yet at the bar it fell to the lot of William H. Seward to show alike his zeal for learning and his devotion to duty when he voluntarily took up the defense of the man Freeman, who had horribly put to death the Van Ness family. The whole region was shaken with horror over the event, and on its being known that the poor wretch whose bloody hand had perpetrated the deed was to be defended by the young and eloquent advocate, who believed the act that of a madman, many of Mr. Seward's best friends tried to dissuade him from appearing in a case whose outcome could only bring down upon his head calumny

and detestation. He persevered. Before the court he produced the highest medical testimony, proving the existence of disease, which he maintained had touched the citadel of the man's reason and destroyed it. His labor for the time was unavailing, but before the day for the execution of the doomed man came death entered his cell door, even as Mr. Seward in his remarkable address to the jury told them medical science indicated. Then came the post mortem examination and lo, the dullest could see that the description Mr. Seward had given of the last stage of the diseased brain was based on unerring scientific research.

The press has lately been discussing the question of momentary or emotional insanity as proved in the Nutt trial at Pittsburg. From the general tenor of its reflections one would suppose that this state of mind was a barrier between the act and the doer of it erected with much pains and skill by the two professions. But it is nothing new. The insanity of Mary Lamb, which in a lurid moment made her a matricide, was of this broken nature.

With what weird words does DeQuincey paint this funereal shadow in the lives of the brother and sister: "Peace for you two, Charles and Mary Lamb! What peace is possible under the curse which even now is gathering against your heads? Is there peace on earth for the lunatic, peace for the parenticide, peace for the girl that without warning and without time granted for a penitential cry to heaven sends her mother to the last audit? Thou, also, thyself, Charles Lamb, thou in thy proper person shalt enter the skirts of this dreadful hail-storm; even thou shalt taste the secrets of lunacy and enter as a captive its house of bondage."

The frequency of Mary Lamb's paroxysms of dethroned reason and the lofty and unshrinking devotion of her brother through forty years of this strange life, is one of the most affecting narratives in the history of this dread disease.

Macbeth thus implores his physicians:

> "Canst thou not minister to a mind diseased;
> Pluck from the memory a rooted sorrow;
> Raze out the written troubles of the brain;
> And, with some sweet oblivious antidote,
> Cleanse the stuffed bosom of that perilous stuff
> Which weighs upon the heart?"

Our asylums for the insane are constantly sending from their doors those whose aberrations of mind have proved to be only temporary and susceptible of alleviation and cure. Doubtless the tribunal that finally determines whether the man was so distempered in mind as to be absolved from the consequences of his deed could be constituted out of better material than it usually is; a body of disinterested educated medical men should listen to this expert testimony, and pass the last opinion upon that phase of the case. But the fact remains that insanity, whether congenital and permanent, or only flecking here and there the lucidity of the mind, must ever be considered as an important legal defense to otherwise

binding acts. Not only does it avoid the punitory result of an otherwise criminal action, but it affects the validity of all contracts, promises and even the most solemn obligations, when assumed under its disturbing presence.

In this vast field of inquiry within which also lie the often contested questions of imbecility, dotage, undue influence, dementia, inebriety and all those conditions of the intellect which are ranged under the phrase non compos mentis, the lawyer and physician find themselves exploring common ground, the one as a zealous advocate seeking to uphold a certain theory, the other as a devotee of science searching only for the truth.

The magnitude, detail and multiform phases of this investigation into the mental capacity augments with the growth, complexity and strain of civilization. The will of a dead millionaire whose life was replete with gigantic business operations and whose genius for accumulating wealth and selfishly conserving it in himself and his chosen son is manifest to the last, is impugned in a court of justices as being the product of a mind wrought upon by sinister influences and innuendoes until its testamentary capacity has gone. The curtains of damask and velvet that hung so thick around the inner life of the man are torn apart by rude hands and the world beholds what chimeras, whims and often inanities dwelt in the nature of the testator. After such an exhibition of wealth and littleness one is almost led to inquire whether, after all, it is not true, as one of the medical men in the Guiteau trial averred, that hardly any man can be set down as always and entirely sane.

The Colonel Dwight case, involving life insurance to an amount of nearly a quarter of a million of dollars, was lately tried and decided in Central New York, on almost wholly medical testimony which took in its range the laws of life and death in a remarkable degree. And on this same expert opinion are founded policies of insurance and payment of death or accident claims annually reaching into millions of dollars. Every policy of insurance represents a doctor's knowledge and a lawyer's skill. Law and medicine are frequently busied with suicides or homicides produced by poison.

The most exciting investigations grow out of this subtle and almost invisible cause of death. The toxicologist with his locked laboratory, sealed jars and potent reagents finally declares whether the particle of tissue submitted to his tests contained a deadly substance, its nature, and whether its approximate quantity was sufficient to destroy life. And over these questions doctors differ and lawyers grow red in the face in quite an astonishing manner.

This contrariety of opinion upon such a grave subject has subjected the medical profession to severe strictures, and yet if the critic would only examine he would find that usually the diversity of opinion grows out of the wisdom, observation and learning of one witness and the want of it in the other. For it is true that there are charlatans in medicine as there are noodles in law. And does not Burns say:

"E'en ministers that hae been kenned,
In holy rapture,
A rousing whid at times to vend,
And nail't wi' scripture."

But somewhere I must close a review which, carried to the end, would consume days. Burke tells us that there are two and only two, foundations of law: "And they are both of them conditions without which nothing can give it force; equity and utility."

"The one is what Philo with propriety and beauty calls the mother of justice," and the other is that "general and public utility connected with and derived from our rational nature."

And of medicine can we not say the same? Does not a lofty integrity inform all its best efforts? And is not beneficence the solid wall supporting its gilded and resplendent home? At the last it ends in this:

To draw from great nature the mysteries of being and its perpetuity to hold in due and proper balance the reciprocal functions of mind and body, and to smooth the downward path of physical life so that when the end comes we may go away from it,

"Like one who wraps the drapery of his couch
About him and lies down to pleasant dreams."

MINERALOGY AND METALLURGY.

THE EARLIEST USE OF IRON.

JAMES M. SWANK.

The use of iron can be traced to the earliest ages of antiquity. It was first used in Asia, the birthplace of the human race, and soon after the time when "men began to multiply on the face of the earth." Tubal Cain, who was born in the seventh generation from Adam, is described as "an instructor of every artificer in brass and iron." The Egyptians, whose existence as a nation probably dates from the second generation after Noah, and whose civilization is the most ancient of which we have any exact knowledge, were at an early period familiar with the use of iron, and it seems probable that they were engaged in its manufacture. Iron tools are mentioned by Herodotus as having been used in the construction of the pyramids. In the sepulchres at Thebes and Memphis, cities of such great antiquity that their origin is lost, butchers are represented as using tools which archæologists decide to have been made of iron and steel. Iron sickles are also pictured in the tombs at Memphis, and at Thebes various

articles of iron have been found which are preserved by the New York Historical Society and are probably three thousand years old. Kenrick, in his *Ancient Egypt under the Pharaohs*, is authority for the statement that Thothmes the First, who reigned about seventeen centuries before Christ, is said, in a long inscription at Karnak, to have received from the chiefs, tributary kings, or allied sovereigns of Lower Egypt, presents of silver and gold, "bars of wrought metal, and vessels of copper, and of bronze, and of iron." From the region of Memphis he received wine, iron, lead, wrought metal, animals, etc. An expedition which the same king sent against Chadasha returned, bringing among the spoil "iron of the mountains, 40 cubes." Belzoni found an iron sickle under the feet of one of the sphinxes at Karnak, which is supposed to have been placed there at least six hundred years before Christ. A piece of iron was taken from an inner joint of the great pyramid at Gizeh in 1837. Both of these relics are in the British Museum. The reference to iron in Deuteronomy iv, 20, apparently indicates that in the time of Moses the Egyptians were engaged in its manufacture, and that the Israelites, if they did not make iron for their taskmasters, were at least familiar with the art of manufacturing it. "But the Lord hath taken you, and brought you forth out of the iron furnace, even out of Egypt." This expression is repeated in I. Kings, viii. 51. A small piece of very pure iron was found under the Egyptian obelisk which has recently been removed to New York.

The use of iron and the art of manufacturing it were introduced into the southern and western portions of Arabia at a very early day, and this may have been done by the Egyptians; it is at least established that some of their own works were located east of the Red Sea. In 1873 the ruins of extensive iron works of great antiquity and of undoubted Egyptian origin were discovered near the Wells of Moses, in the Sinaitic Peninsula.

The country which lay to the south of Egypt is supposed to have produced iron in large quantities. Iron was also known to the Chaldeans, the Babylonians, and the Assyrians, who were cotemporaries of the early Egyptians. Some writers suppose that the Egyptians derived their supply of iron principally from these Asiatic neighbors and from the Arabians. Babylon was built about seventeen centuries before Christ, and Nineveh was of about equal antiquity. Iron ornaments have been found in Chaldean ruins, and Chaldean inscriptions show that iron was known to the most ancient inhabitants of Mesopotamia. In the ruins of Nineveh the antiquarian Layard found many articles of iron and inscriptions referring to its use. Among the articles discovered by him were iron scales of armor, from two to three inches in length. "Two or three baskets were filled with these relics." He also found "a perfect helmet of iron, inlaid with copper bands." In the British Museum there are preserved several tools of iron which were found at Nineveh by Layard, including a saw and a pick. The art of casting bronze over iron, which has only recently been introduced into modern metallurgy, was known to the Assyrians. At Babylon iron was used in the fortifications of the city just prior to its capture by Cyrus, in the sixth century before Christ. In a celebrated inscription Nebuchadnezzar declares: "With pillars

and beams plated with copper and strengthened with iron I built up its gates." The huge stones of the bridge built by his daughter, Nitocris, were held together by bands of iron fixed in place by molten lead.

The Book of Job, which relates to a patriarchal period between Abraham and Moses, contains frequent references to iron, even to "bars of iron," "barbed irons," "the iron weapon," and "the bow of steel." In the 28th chapter and 2d verse it is declared that "iron is taken out of the earth." In the 19th chapter and 24th verse the "iron pen," which could be used to engrave upon a rock, is mentioned. Job is supposed to have lived in the northern part of Arabia, in the Land of Uz, which was separated from Ur of the Chaldees, where Abraham was born, by the Euphrates. Iron ore of remarkable richness is still found between the Euphrates and the Tigris.

Moses led the children of Israel out of Egypt fifteen or sixteen hundred years before the Christian era. In the story of their wanderings iron is frequently mentioned. In Leviticus, vii. 9, the frying-pan is mentioned. When the Israelites under Moses spoiled the Midianites they took from them iron and other metals; when they smote Og, the King of Bashan, they found with him an iron bedstead. Canaan, the Land of Promise, was described by Moses in Deuteronomy, viii. 9, as "a land whose stones are iron." Iron is still made in the Lebanon Mountains. In Deuteronomy, xxvii. 5, 6, and in Joshua, viii. 31, the use of iron tools in building an altar of "whole stones" to the Lord is prohibited, which shows that, not only did the Israelites in the days of Moses have a knowledge of iron tools that would cut stone, but that the Egyptians must have possessed the same knowledge. After the Israelites came into possession of Canaan iron is frequently mentioned in their history, some of the earliest references being to chariots of iron, which the Canaanites used in their wars with them, and which were probably armed with iron scythes. Chariots of the same kind were doubtless used by the Egyptians. Frequent mention is made of agricultural implements and tools of iron, and of iron weapons of war. In the description of the armor of Goliath it is said that "his spear's head weighed six hundred shekels of iron." Axes and saws and harrows of iron are mentioned in the reign of David, and axes and hammers and tools of iron in the reign of Solomon. Isaiah also speaks of harrows of iron. Daniel says that "iron breaketh in pieces and subdueth all things." When David, about a thousand years before Christ, made preparations for the building of the temple he "prepared iron in abundance for the nails for the doors of the gates and for the joinings;" and in his instructions to Solomon concerning it he said that he had prepared "brass and iron without weight," and that of gold, silver, brass, and iron "there is no number."

It would appear that the Israelites in the early part of their history were not skilled in the manufacture or manipulation of iron, but were greatly dependent upon their neighbors for iron itself and for the skill to fashion it. In the reign of Saul, because of the oppression of the Philistines, "there was no smith found throughout all the land of Israel; but all the Israelites went down to the Philistines to sharpen every man his share, and his coulter, and his axe, and his mat-

tock." When Solomon came to build the temple he sent to Hiram, King of Tyre, for "a man cunning to work in gold, and in silver, and in brass, and in iron." The Phœnicians were celebrated as workers in all the metals.

In Jeremiah, xv. 12, the question is asked by the prophet: "Shall iron break the northern iron, and the steel?" The northern iron and steel here referred to were probably products of Chalybia, a small district lying on the south-eastern shore of the Euxine, the inhabitants of which, called Chalibees or Chalybians, were famous in the days of Asiatic pre-eminence for the fine quality of their iron and steel. Herodotus, in the fifth century before Christ, speaks of "the Chalybians, a people of iron-workers." They are said to have invented the art of converting iron into steel, but it is probable that, as they used magnetic sand, they made steel mainly. Latin and Greek names for steel were derived from the name of this people. From the same source we obtain the words "chalybean" and "chalybeate."

But other eastern nations doubtless made steel at as early a day as the Chalybians. In Ezekiel, xxvii. 12, the merchants of Tarshish are said to supply Tyre with iron and other metals, and in the 19th verse of the same chapter the merchants of Dan and Javan are said to supply its market with "bright iron." Tarshish is supposed to have been a city in the south of Spain, and Dan and Javan were probably cities in the south of Arabia. The name Tarshish may, however, have referred generally to the countries lying along the western coast of the Mediterranean and beyond the Pillars of Hercules. Dan and Javan may have supplied iron made in the southern part of Arabia, or they may have traded in the "bright iron," or steel, of India. The period embraced in the references quoted from the prophet was about six hundred years before Christ. Both Tyre and Sidon traded in all the products of the East and the West for centuries before and after Ezekiel, and iron was one of the products which they supplied to their neighbors, the Israelites.

The Persians and their northern neighbors, the Medes, made iron long before the Christian era, and so did the Parthians and other Scythian tribes. The Parthian arrow was first tipped with bronze, but afterwards with steel. The Parthian kings are said to have engaged with pride in the forging and sharpening of arrow-heads. Iron is still made in Persia by primitive methods.

India appears to have been acquainted with the manufacture of iron and steel from a very early period. When Alexander defeated Porus, one of the Punjaub Kings, in the fourth century before the Christian era, Porus gave him thirty pounds of Indian steel, or wootz. This steel, which is still made in India and Persia, was a true steel, and of a quality unsurpassed even in our day. It was and still is manufactured by a process of great simplicity, similar to that by which crucible steel is now manufactured. Long prior to the Christian era, as well as for many centuries afterwards, Damascus, the Capital of Syria, manufactured its famous swords in part from Indian wootz. The people of India further appear to have become familiar, at an early period in their history, with processes for the manufacture of iron on a large scale, which have since been lost. It is

circumstantially stated that a cylindrical wrought-iron pillar is now standing at the principal gate of the ancient mosque of the Kutub, near Delhi, in India, which is about sixty feet long, sixteen inches in diameter near the base, contains about eighty cubic feet of metal, and weighs probably over seventeen tons. The immense proportions of this pillar are not more striking than its ornate finish. An inscription in Sanscrit is variously interpreted to assign its erection to the ninth or tenth century before the Christian era or to the early part of the fourth century after it. In the ruins of Indian temples there have been found wrought-iron beams similar in size and appearance to those used in the construction of buildings at the present time. Metallurgists are unable to understand how these large masses of iron could have been forged by a people who appear not to have possessed any of the mechanical appliances for their manufacture which are now necessary to the production of similar articles.

The period at which China first made iron is uncertain, but great antiquity is claimed for its manufacture in that mysterious country. In a Chinese record which is supposed to have been written two thousand years before Christ iron is mentioned, and in other ancient Chinese writings iron and steel are both mentioned. Pliny the Elder, writing in the first century of the Christian era, thus speaks of the iron of China, the inhabitants of which were known in his day as the Seres: "Howbeit, as many kinds of iron as there be, none shall match in goodness the steel that cometh from the Seres, for this commodity also, as hard ware as it is, they send and sell with their soft silks and fine furs. In a second degree of goodness may be placed the Parthian iron."

It may be assumed as susceptible of proof that the knowledge of the use of iron, if not of its manufacture, was common to all the people of Asia and Northern Africa long previous to the Christian era. The Phœnicians would carry this knowledge to their own great colony, Carthage, which was founded in the ninth century before Christ, and to all the colonies and nations inhabiting the shores of the Mediterranean. Phœnician merchants obtained iron from such distant countries as Morocco and Spain, and possibly even from India and China, as well as from nearer sources. But in time the merchants of Tyre and the "ships of Tarshish" deserted the places that long had known them, empire after empire fell in ruins, and with the fading away of Asiatic and African civilization and magnificence the manufacture and the use of iron in Asia and Africa ceased to advance. Egypt has probably not made iron for nearly three thousand years, and probably no more iron is made in all Asia to-day than was made in its borders twenty-five centuries ago, when Babylon was "the glory of kingdoms, the beauty of the Chaldees' excellency."—*U. S. 10th Census Report.*

THE SUPPLY OF COAL.

PROF. D. E. LANTZ.

The attachments made by the American Forestry Association to the effect that our forests are suffering rapid destruction and that in a very limited number of years our timber supply will be exhausted, must have caused alarm in the minds of many people who live remote from the coal supply. Then, too, the mass of mining and commercial statistics, published from time to time at our great centers of coal distribution, must have increased the apprehensions as to the sufficiency of the fuel supply of the world.

But now comes the recent report of the U. S. Geological Survey with many consolatory figures on the coal supply of this country and Europe. This shows us that the enormous increase in the consumption of coal does not threaten an immediate failure in the world's supply.

The report places the area of the productive coal fields of this country at 192,000 square miles. That of Great Britain is put at 12,000 square miles. Exclusive of China, the entire production of the world is estimated at 360,890,000 tons. Of this aggregate, Great Britain furnished 154,000,000 tons, Germany furnished 61,000,000 tons, and our own country 92,000,000 tons, two-thirds of which was bituminous coal.

During the last twelve years, the annual product of the mines in the United States has increased 50,000,000 tons; but we have as yet touched only the surface of our coal resources. It is probable that the area of our coal fields is greatly underestimated. A producing capacity of 3,000,000 tons per square mile would be a small estimate of our supply. At this estimate, with an annual consumption of 360,000,000 tons, it would require 120 square miles a year to supply the world; and the coal in the United States alone would furnish this supply for 1600 years.

But the report does not include China, Borneo, Japan, and other countries whose coal statistics are not available. In China, several provinces contain great coal areas. Hoo-Nan alone has 2,700 square miles of anthracite coal fields. German scientists estimate that there is coal enough in China to supply the entire world for some hundreds of millions of years. Even England has coal enough to supply her own needs for three hundred years. In view of all this, it does not at present seem necessary to feel anxious about the supply of fuel in this or any other country.

But Kansans are more directly interested in obtaining their fuel supply cheap. Here at Manhattan, anthracite coal sells at $14 a ton. At the mines in Pennsylvania it costs less than a fourth of this sum. The expense of transportation more than quadruples the original cost. The semi-bituminous coal of Colorado costs us from $7 to $10 a ton. It may be consoling to learn that there

is an abundant supply of anthracite coal in the mountains of Colorado, and that efforts are being made to bring this supply to our markets at such rates as will be remunerative to operators, and at the same time within the financial reach of the great mass of consumers.—*Industrialist.*

KANSAS COAL.

Six years ago where the two towns, Pittsburg and Weir City, are now the scene of business activity, and embracing a population aggregating 8,000 to 10,000 people, the country was nothing but raw prairie. Inexhaustible supplies of coal were discovered, and next in turn the workers in lead and zinc ores discovered they could transport the ores to the coal and manufacture them into merchantable lead and zinc much cheaper than bring the coal to the ore deposits. Pittsburg grew, Weir City grew, and around these two industrial centers, in Crawford and Cherokee Counties farm lands have enhanced in value from $5 per acre, six years ago, to $25 and $30 per acre, while the farmers are selling hams of their own raising for sixteen cents per pound, which brought four cents per pound when the smelters were first located; and so on have they found a ready and remunerative market for their labor since manufacturing has been established in their midst.

Without taking into account any other material than coal, what is true of the Second district can be wrought out of the future in other parts of Kansas, for the coal formation is widespread and inexhaustible throughout the State. The mining of coal in Kansas is comparatively an infant industry, one of a few year's growth only; but so far as it has progressed, the enterprise has proved satisfactorily remunerative, and has demonstrated that Kansas coal is the best for all domestic and steam purposes offered in the markets of the West.

Though only an infant industry, the possibilities of coal mining in Kansas with the attendant industries it is bound to attract, are manifestly shown by State Inspector Scammon's report regarding the coal mines, mining and the employment given in Kansas. His report embraces a period extending only from July 1 to December 31, 1883, the law creating his office going into effect on the former date. From the report, the industry in the State is represented by the following figures for the six months of the year beginning July 1 and ending December 31, 1883:

Bushels mined	13,377,875
In tons	535,115
Number of miners	2,833
Number of other employes	671
Total employes	3,504

Quoting the report it shows the wide extent of the deposits, the magnitude of the industry and the fair remuneration to those engaged in the industry.

In Osage County there are eighty-four coal shafts (five are stopes, but here for brevity considered shafts) located as follows:

Osage City and vicinity	31
Peterton	5
Dragoon	3
Burlingame	12
Scranton	17
Carbondale	14

Of this number, ten are worked out or abandoned, and in the month of December twelve were not operating, leaving sixty-two in operation—quite a number of these working but a few men. These shafts all operated by horse-power.

No. bushels of coal mined in Osage County	4,723,376
No. of miners	1,518
No. mine bosses and weighers	127

This classification of men is made because the miners are paid by the bushel and mine bosses and other employes are paid by the day or month.

Amount of coal mined per each miner, 3,110 bushels; per day for each miner, allowing 150 working days, twenty-one bushels; amount of money paid miners, $330,500; per miner, $217. Mining bosses and laborers not included, just actual diggers paid that amount.

Had the demand for coal been good and mining active the business would have been easily one-third larger and these figures correspondingly larger.

In addition to above amount of coal there was of stripped coal in the vicinity of Scranton and Carbondale, 707,153 bushels. Ninety teams and 120 men in stripped coal.

Thus, in Osage County, the output of coal for the last six months of 1883, was 5,429,520 bushels.

Miners employed	1,564
Laborers and strippers	201
Total	1,765

This does not include operators, superintendents, office-men, etc.

The coal mines in Cherokee and Crawford Counties are generally considered one coal district, the mines being located in the northern part of Cherokee and southern part of Crawford County: they are properly considered one district, and in this report I combine the two counties and give the business and output as one district.

There are twenty-five shafts (two of which are stopes); of these all but two are in operation.

Located north of Columbus	1
Newcastle	1

Stillson	1
Scammonville	4
Weir City	8
Pittsburg	5
Litchfield	2

Of these fourteen are operated by steam-power and eleven by horse-power.

Output of coal, bushels	5,796,877
No. of miners	817
Pit-bosses and employes	215
Amount mined per each miner, bushels	7,095
Per day each miner, allowing 150 working days, bushels	47
Amount paid miners	$217,000
Amount paid each miner	205

The average amount of coal mined by each miner appears small, but this calculation is made from the number of miners at work in November, which is larger than an average of the six months would be. The business would have been one-third larger had the demand warranted it.

Stripped coal in this district, 235,000 bushels, employing thirty-five teams and sixty men; total output in district, 6,031,877 bushels.

Number actual miners	835
Engineers, laborers and strippers	277
Total	1,112

Operators, superintendents and office men not included.

Leavenworth County, bushels	953,699
No. of miners	200
Other employes	162
Total	362
Penitentiary shaft, bushels	504,064
No. of miners (convicts)	131
Laborers	15
Total	146

There are several smaller mining districts in the State from which I have partial returns, and from some I have none. The reports I have combined in the following statement from Ellsworth, Russell, Neosho, Franklin, Bourbon and Linn Counties.

No. of bushels of coal mined	458,715
No. of miners	103
Laborers	16

Kansas has the wealth of Colorado's gold and silver mines in her coal mines, when fully developed, and seconded in their productive power by the manufactories, they will attract attention and capital in the near future.—*Kansas City Journal.*

TIN ORE.

The public has so often been advised of the discovery of tin deposits of commercial value through premature and in some instances groundless reports that it is scarcely in a humor to credit such statements now, even though they come from respectable authorities. Casserite tin, it is known, occurs in several widely distant localities in the United States, but inasmuch as capital has never been largely enlisted in developing the occurrences the notion obtains that they are of mineralogical interest only, and as regards most of them this is undoubtedly true. Still the possibility of building up a domestic tin-plate industry, should really valuable deposits be discovered, encourages the hope that somewhere in our vast domain tin occurs in such quantities and of such quality as to be commercially valuable.

The most promising occurrence of tin ore thus far made known probably is in the neighborhood of Custer City, Dakota. This district was visited by Prof. Blake some time ago, and from a letter of his to the *Engineering and Mining Journal* we quote as follows:

* * * Since my former communication upon the discovery of tin ore in the Black Hills of Dakota, other localities have been found. One especially, upon Spring Creek, is worthy of notice. The ore occurs there not only in alluvial deposits, in crystalline grains and masses about the size of grains of corn, but in veins of considerable extent and regularity. Samples sent to me show tin stone (black tin) disseminated in a gangue or veinstone of white quartz, with a little white mica in small crystals, thus approximating to the composition of typical "griessen." The chief vein is said to be about three feet wide, and to be traceable, but with occasional breaks and interruptions for a mile or more. It traverses a mica slate. * * * Development work has begun on the Etta or Tin Mountain claims, and the ground opens in a very encouraging way, showing large masses of the griessen, well charged with casserite. A mill has been contracted for and will soon be erected for the purpose of crushing and concentrating this ore. As the concentrations will be very pure and of high grades it is proposed to ship them to a smelter until arrangements are made for smelting at the locality.

Prof. G. F. Randall, of London, England, has also visited this district, and expresses the belief that "the tin mines of the Harney Range will control the markets of the world."

In the Temescal Range, San Bernardino County, California, 400 or 500 tin claims were reported located a year or so ago, but only one mine, the Cajaica,

was developed to any extent. Very little has been said of the Temescal Range of late, from which it may be inferred that the yield of tin has fallen below expectations, and that work has been abandoned on most if not all of the claims. An analysis of the Temescal ore made by Dr. F. A. Genth gave the following results: Silicic acid 9.82, tungstic acid .22, oxide of tin 76.15, oxide of copper .27, oxides of iron and manganese, lime and alumina 13.54; total 100.

The tin occurrence upon which development work has been most actively and energetically carried forward in this country is that upon which the Broad Arrow Mines are located, near Ashland, Clay County, Alabama. The ore in that locality occurs both in lodes and as stream tin, and has been uncovered in four places, and these four open quarries constitute the Broad Arrow Mines. The tin stuff ranges from a trace up to two per cent, averaging one and a half per cent; and is said to be readily concentrated, and is besides free from all traces of arsenic and sulphur. Reduction works have been erected near the quarries since regular work began at the mines, March 2, 1883, the intention being to produce from gneiss ore carrying one and a half per cent tin about 500 pounds of crude pig tin a day. It is our information that the venture has not thus far been a commercial success.

Quite recently it has been noised about that tin ore has been discovered in Rockbridge County, Virginia. The ore is said to be found in Irish Creek, a few miles from the line of the Shenandoah Valley Railroad, near Vesuvius and Midvale Stations. Owing to the altitude of the locality, 2,700 feet above tide water, work can only be carried forward during warm weather, and as yet enough has not been done to determine the extent of the deposit. The ore has been cut at several points by shafts, however, and its richness pretty well determined by numerous analyses. It is of the variety known as casserite, or binoxide of tin, according to one authority, and from a specimen broken from the vein showed M. tin 63.583, M. iron 1.680, silica 8.415, sulphur .066, arsenic .301, titanium distinct trace. Other analyses gave varying results. One by Prof. A. S. McCreath of the average across the cut, taking tin stuff, quartz and wall rock, gave M. tin 31.63; one by Prof. Silliman, of Yale, of the best casserite sample gave M. Tin 68.00; one by Prof. Potter, of St. Louis, gave M. tin 63.81.—*Age of Steel.*

Influence of Scientific Studies.—While it must be conceded that force of expression and faculty in the communication of thought are best to be acquired through the philosophical, dialectical, rhetorical studies and exercises which in the main compose the curriculum of older institutions of our country, I believe it to be equally true that the faculties of clear perception, of careful discrimination, and of just generalization are developed by the study of natural history, of chemistry, of physics, as they can be through no other educational means.—*Gen. F. A. Walker, Boston.*

ENTOMOLOGY.

DISTRIBUTION OF THE COLEOPTERA OF KANSAS.

WARREN KNAUS.

The beetle fauna of Kansas is, in many respects, extensive and varied. This may seem to be the more remarkable, when we take into consideration the fact that the general surface of the State is almost entirely uniform throughout; no mountain ranges that serve to mark the habitat of distinct coleopterous tribes and families; no considerable elevations even, but a continuous undulating plain, covered over a great part of the surface by grass only, the forests being confined to the margins of the streams over the eastern half of the State, and scarcely existing at all over the western half.

This sameness of surface and vegetation,—the tendency of which is toward the uniformity of the beetle fauna,—is however, in almost direct contrast to the diversity incident on the geographical situation of the State. The late Dr. J. L. Leconte, in his geographical subdivision of the coleopterous fauna of the United States, says in effect;—that the whole region of the United States is divided by meridional lines into three, or perhaps four, great zoölogical districts, distinguished each by numerous peculiar genera and species, which, with but few exceptions, do not extend into the contiguous districts.

The central district, according to Leconte, extends from the prairies west of Iowa, Missouri and Arkansas, westward to the Sierra Nevadas.

Since the beetles of this region have become better known, however, it is, I think, generally considered that the Rocky Mountain region and the plains at its eastern base constitute a separate division, the coleopterous fauna of which is entirely different from that in the central division.

According to this division Kansas is located practically in three faunal regions, and her beetle forms are varied accordingly. The eastern portion of the State has many representatives from the eastern division of the United States; the central portion has a fauna of its own, and the western portion partakes largely of the fauna of the plains. Her fauna is still further increased by the addition, along the southern boundary of the State, of a number of forms peculiar to the subtropical fauna of the southern States. Contrary, therefore, to an early expressed opinion of one of our most noted coleopterists, Kansas is characterized by the variety and richness of her beetle families. The total number of species and varieties of Kansas coleoptera up to the close of 1883, I have summarized as follows:

Families.	Species and Varieties.
1. Cicindelidæ	32
2. Carabidæ	255
3. Haliplidæ	3
4. Dyticidæ	36
5. Gyrinidæ	5
6. Hydrophilidæ	27
7. Trichopterygidæ	2
8. Staphylinidæ	141
9. Pselaphidæ	6
10. Sylphidæ	18
11. Scydmænidæ	2
12. Corylophidæ	6
13. Scaphidiidæ	9
14. Lathridiidæ	4
15. Dermestidæ	16
16. Endomychidæ	5
17. Tritomidæ	9
18. Sphindidæ	1
19. Cioidæ	5
20. Erotylidæ	17
21. Atomariidæ	11
22. Cucujidæ	6
23. Bitomidæ	4
24. Colydiidæ	9
25. Rhyssodidæ	1
26. Rhizophagidæ	5
27. Trogositidæ	9
28. Nitidulidæ	30
29. Phalacridæ	7
30. Coccinellidæ	49
31. Cistelidæ	2
32. Parnidæ	3
33. Elmidæ	3
34. Heteroceridæ	6
35. Histeridæ	41
36. Lucanidæ	7
37. Scarabeidæ	132
38. Duprestidæ	55
39. Throscidæ	5
40. Elateridæ	73
41. Rhipiceridæ	3
42. Dascyllidæ	7
43. Lampyridæ	23
44. Telephoridæ	25
45. Malachiidæ	18
46. Cleridæ	32
47. Lymelexydæ	1
48. Cupesidæ	1
49. Ptinidæ	23
50. Spondylidæ	1
51. Cerambycidæ	122
52. Bruchidæ	21
53. Chrysomelidæ	229
54. Tenebrionidæ	58
55. Allecullidæ	8
56. Lagriidæ	1
57. Pyrochroidæ	1
58. Anthicidæ	26
59. Melandryidæ	15
60. Mordellidæ	34
61. Meloidæ	34
62. Oedemeridæ	4
63. Rhynchitidæ	9
64. Attelabidæ	2
65. Byrsopidæ	1
66. Otiorynchidæ	22
67. Curculionidæ	162
68. Brenthidæ	2
69. Calandridæ	26
70. Scolytidæ	7
71. Anthribidæ	7
72. Apionidæ	3
Total Species and Varieties.	1,975

The total number of forms of Kansas coleoptera so far as identified, exceeds those of any other State or Territory, except I believe, Michigan with about 3,500 forms, and the District of Columbia with 2,600.

In glancing over the above summary, we notice at once the large number of forms in the first family, the Cicindelidæ. Out of a total of about one hundred

forms in North America north of Mexico, of this family, one third are taken in Kansas. This large number necessarily includes many of the most desirable species for the cabinet of the collector; among which may be mentioned the Amblychila Cylindriformis, Say., of western Kansas, the largest, and until within a few years, the rarest of North American tiger beetles. Two other tiger beetles that have been taken abundantly in the last two or three years, are C. Circumpicta, Laf., southeast Kansas, and C. Belfrangei, Sallei, of central Kansas. These are both salt-marsh or fluviatile species.

The ground-beetles (carabidæ,) are found more abundantly over the central and eastern divisions of the State, being so far as known, more restricted toward the west. This family has been studied more closely than any other in the State, and stands at the head in the number of its forms.

The water beetles, (Dyticidæ and Hydrophilidæ,) are also more common throughout the eastern half of the State. Another numerous family, very abundant in eastern Kansas and extending westward, is that of the short-winged scavengers, (Staphylinidæ). One of the most extensive families in its diffusion throughout the State is the Scarabeidæ. The large Copris Carolina, Linn., of this family is found in the east; the splendid "Goldsmith Beetle" (Cotalpa Lanigera,) from east to west. And the giant of North American beetles—the Hercules—(Dynastes Tityus,) is taken in the extreme southern part of the State. The other families are of general distribution. The species of the eastern fauna disappearing frequently and giving place to the fauna of the plains, are those of the Buprestidæ, Elateridæ, Cerambycidæ, Chrysomelidæ, Tenebrionidæ, Meoidæ, and Curculionidæ families. Of these, the last five families contain in the western half of the State, many large and interesting species not found in eastern Kansas. This makes western Kansas—possessing as it does so many species typical of the plains fauna—one of the most desirable collecting grounds in the United States.

As yet the coleopterous fauna of the State has received, except in very restricted localities, but very superficial study, and the student and collector will find a rich field for investigation for years to come.

MEDICINE AND HYGIENE.

STEAM-HEATING.

PROF. W. P. TROWBRIDGE.

To the architect and sanitary engineer of the present day the terms warming and ventilation have certain technical meanings, and when employed together refer to systematic arrangements and appliances in the construction of dwellings, public buildings, churches, and halls of audience, by which not only may suita-

ble temperatures be maintained in these structures, but proper quantities of pure and fresh air supplied continuously. It may be laid down as a fundamental principle that the warming and the ventilation of dwelling-places are equally indispensable to health, and that they are, to a great extent, inseparable in their relation to each other, and, ordinarily, in the appliances by which they are effected.

Four modes of heating, which furnish at the same time different degrees of ventilation, comprise all in common use, viz.: the open fire-place, the close stove, the hot-air furnace, and the steam-heating apparatus. A comparison of these methods involves, for each, the cost of the apparatus and its durability, the cost of fuel and attendance, and the efficiency of the apparatus for heating and ventilation.

The open fire and the stove furnish means for a constant supply of heat, through combustion of fuel, within the room to be heathed. The open fire gives off its heat to the walls and objects in a room only by radiation from the burning fuel, all the air that passes the heated surfaces of the fire-place going directly up the chimney. Hence, this method is inefficient for heating, especially when the walls of the room in which the fire is placed are greatly exposed to outside cooling influences. Moreover, much more air than is necessary for combustion passes up the chimney, from the very nature of its construction; and as this air must pass through the room to the chimney, it is difficult in general to avoid cold currents of air. Remote corners are apt to receive little heat directly, and the full effect of the open fire for a dwelling, requiring as it must, a fire for each room, is attained only at a great expense of fuel. While the first cost of the fire-place may not be great, the cost of fuel, except when such open fires are mere adjuncts to some other system, renders this mode of heating, as houses are now constructed and occupied, quite out of the question for the ordinary householder. As regards ventilation, however, the open fire is of all systems the most admirable.

The second mode of heating, the close stove, is doubtless of all modes the most universally practiced at the present day. Whether the stove be a simple structure of cast or wrought iron, having an interior chamber for the combustion of fuel, with a plain wrought-iron pipe to lead away the gases of combustion, or whether this simple structure be incased or provided with additional chambers and pipes for the more extended circulation of the heated gases, and to furnish the greatest possible heating surface, the statistics of manufacture alone furnish evidence that there is some especial advantage in this mode of heating which commends it to popular favor. It is not difficult to account for the preference: the stove can be placed at little expense in any room of any building where there is a flue for carrying off the smoke and the gases of combustion. The activity of the fire can be modified at will to suit any degree of external temperature; and as it is generally employed with the minimum amount of ventilation, and often with almost none at all, the economy of heat is all that can be desired. But in proportion as an active and sufficient ventilation is demanded, this effi-

ciency of heating disappears; and since the usual practice is to trust for ventilation to the accidental influx of air through crevices in the window and door casings, the use of stoves is quite sure to lead to a vitiated atmosphere. Owing to the fact that the heating appliances of both the open fire and the stove are confined almost entirely to the room or apartment in which the fuel is burned, the heating of a building comprising many apartments, by these methods, can only be accomplished by increasing the number of fires or stoves. The economy which might be practicable for a single room then disappears to a great extent, owing to the increased cost of attendance, as well as waste.

Two modes of heating are in vogue by which the demands of economy and comfort are then met, viz.: the hot-air furnace and the steam-heating apparatus. The hot-air furnace is simply an encased stove outside of, and away from, the apartments to be heated, generally in the cellar or basement of a building. The casing or chamber within which the stove is placed is put in communication with the external air by an inlet conduit, which serves the double purpose of furnishing air for combustion and for supplying a number of rooms with heated air. To effect this two-fold purpose, there is a chimney direct from the stove for the removal of the gases of combustion, and one or more flues leading from the air-chamber around the stove, with branches for the different apartments, for that portion of the air which comes in contact with the heated surfaces of the stove and casing, and which then passes to the rooms. The air is usually heated to a temperature of 250° to 400°, and by mixture with cold air may be brought down to 150° to 200°, at which temperature it will enter the rooms. Air at these high temperatures must be further reduced in temperature and mingled with cold air in the rooms to be warmed, and for effecting this object reliance is generally placed on the accidental leakage at doors and windows. The expulsion of the heated air is accomplished by a spontaneous draft through flues from the heated apartments to the roof, or into halls and thence to upper stories.

A single furnace may thus heat very economically an ordinary dwelling; but the disadvantages and defects of the system are numerous. Beyond a certain limited distance from the furnace the difficulty of conveying heated currents in this manner increases very rapidly; and where there are branch ducts leading to many rooms, one branch may overpower another, causing excessive heat in one room and a deficiency in another. The proper ventilation of apartments is difficult, and the highly heated currents, having an increased capacity for moisture, are apt to convert the rooms to be heated into drying chambers, to an extent that is neither agreeable nor healthful. A few open fires, arranged to produce proper ventilation, mitigate very much some of these evils. For large buildings several hot-air furnaces must be provided, and the economy is proportionally diminished.

All of the above described methods have been supplanted to some extent, in this country at least, by steam-heating apparatus, or its practical equivalent in limited circuits, the hot-water apparatus. Even for ordinary dwellings, this

system is being gradually extended; while for large blocks, such as apartment houses, hotels, manufacturing establishments, school-houses, and other large structures, the system is so greatly in demand as to have given rise to new and extensive industries devoted to the manufacture and installment of the necessary apparatus.

Steam heating is characterized by the fact that the heat is generated in the furnace of a boiler either within or without the walls of the building to be heated, the heat of combustion being transferred to water, which, being vaporized, constitutes the medium by which the heat is conveyed in comparatively small pipes to the points where it is utilized for heating purposes. Two distinct methods of utilizing this heat are practiced. In one the steam pipes are carried, by the most convenient course, directly into the room or space to be heated, where, by convolutions of the pipes, or what are known as radiators, an extended heating surface is furnished to the room. These coils, or radiators, give off heat both by radiation and by contact with the air, which is kept slowly circulating, as in the case of a close stove; and it is evident that only a feeble, or at least uncertain, ventilation is possible, except through special arrangements made for introducing fresh air. These heated coils are, in effect, identical with close stoves, the only difference being that the surfaces of the coils can never be heated to a degree higher than that of the steam,—practically, never higher than 310° nor lower than 215° or 220° Fahr., while the surface of the close stove may, under some circumstances, approach 950°. Active and sufficient ventilation may be attained with these coils, however, if they are placed in such a way that cool air, introduced through openings,—as, for example, under windows—will mingle directly with the heated air rising from the radiators, and then be deflected upward to be mixed with the general circulation, and discharged through ventilating flues. Of course, such active ventilation can only be attained at the expense of additional heat.

The other method, called by a strange misconception "indirect radiation," consists in conveying the steam from the boiler to small chambers constructed for the purpose, in the basement, directly beneath the rooms to be warmed. Here the steam pipe is extended into a coil, or an equivalent arrangement, by which a large amount of steam-heated surface is exposed. Flues for heated air lead from the roof of the chamber to the various rooms to be heated; an inlet duct for fresh air enters the bottom of the chamber, and the coils, or "radiators" are so arranged that the air in rising comes in contact with the heated surfaces, and passes to the apartments to be warmed with the temperature increased to 70° or 100° Fahr. Low temperature currents only are generated; and as the proper action of the apparatus can be kept up only by a continuity of flow into and out of the space to be heated, the two effects of heating and ventilation are most effectively conbined.

A comparison of these various methods must include the cost of the apparatus, the cost of attendance, the cost of fuel, and the incidental advantages and disadvantages belonging to each. The open fire-place possesses the advantage

of giving thorough ventilation, but it is the most expensive in fuel. The close stove is highly advantageous in point of economy, where there is little ventilation, and as this is apt to be the rule, it is perhaps the least healthful of all methods as generally applied. Both of these methods become costly in attendance as well as in fuel when the heating of dwellings of many rooms is required, and are inapplicable to large structures and public buildings as they are now constructed. The hot-air furnace system is of all the most difficult to manage, so far as uniformity and control of temperature is concerned. The danger from fire, the dust, the defective ventilation, and the impracticability of heating more than a limited space by a single hot-air furnace are other defects inherent in this system. Steam heating involves greater first cost in apparatus than any other system. When this cost and the cost of attendance and repair are taken for a series of years, however, it is conceded that there is but little choice between hot-air furnaces and steam-heating apparatus as regards economy.

The special advantages of steam heating are:

1. The almost absolute freedom from risk of fire when the boiler is outside of the walls of the building to be heated, and the comparative immunity under all circumstances.

2. When the mode of heating is the indirect system, with box-coils or heaters in the basement, a most thorough ventilation may be secured, and it is in fact concomitant with the heating.

3. Whatever may be the distance of the rooms from the source of heat, a simple steam-pipe of small diameter conveys the heat. From the indirect heaters underneath the apartments to be heated, a vertical flue to each apartment places the flow of the low heated currents of air under the absolute control of the occupants of the apartment. Uniformity of temperature, with certainty of control, may be thus secured.

4. Proper hygrometric conditions of the air are better attained. As this system supplies large volumes of air heated only slightly above the external temperature, there is but little change in the relative degree of moisture of the air as it passes through the apparatus.

5. No injurious gases can pass from the furnace into the air flues.

6. When the method of heating is by direct radiation in the rooms, the advantages of steadiness and control of temperature, sufficient moisture and good ventilation, are not always secured; but this is rather the fault of design, since all these requirements are quite within the reach of ordinary contrivances.

7. One of the conspicuous advantages of steam heating is that the most extensive buildings, whole blocks, and even large districts of a city, may be heated from one source, the steam at the same time furnishing power where needed, for ventilation or other purposes, and being immediately available also for extinguishing fires, either directly or through force pumps.

It is only to be remarked, finally, that the most thoughtful among our physicians and sanitary advisors realize with anxiety the fact that there is a growing abuse of all these systems, except the open fire, in providing too much heat and

too little ventilation. There is no mode of heating which lends itself to the correction of this evil so readily, however, as the steam-heating method. With proper care on the part of architects in arranging inlet ducts for fresh air, and ventilating flues heated by steam coils to accelerate the draft, any desirable degree of ventilation with low temperature currents may be secured. Such arrangements should, however, be studied in advance, and form principal elements in the design of a building, instead of being wholly subordinate, as is commonly the custom, to less important architectural features. It should be regarded as a fundamental principle in architecture, that the first and most important problem to be studied, after the general design of a building is determined, is the proper positions and magnitudes of heating and ventilating appliances for the structure as a whole, and for each room in particular; and not only should the details of the main and cross walls be modified and adapted to these arrangements where it is necessary, but no question of mere architectural propriety or appearance, nor even of convenience in use, should be allowed to interfere with objects so important to health as good and sufficient warming and ventilation.—*North American Review.*

ENGINEERING.

THE OHIO RIVER FLOOD OF 1884.

REV. ALBERT E. WELLS.

Every year we are led to expect a flood on the Ohio River. It appears from the papers that an annual record of these overflows has been kept since 1832. Yearly for half a century has some part of the valley been flooded. Now it is a river of great utility, the instrument of an enormous trade, the drain of one of the most fertile valleys in the world; a valley thickly settled by a thrifty and intelligent people, none more so in our country, and by fifty years experience it is known that there will be an overflow. It is time that some reflections should be drawn from so regular an occurrence. And so we have an abundance of press items and advice upon the subject. The one seeming most sensible to me of those that have come under my notice is that of Capt. J. P. Walker, of the United States Army. He suggests a system of reservoirs, and so practically endorses the article in your magazine of August, 1883, over my signature.

The valley of the Ohio contains 207,111 square miles. Its rainfall is given as forty-three inches to the square foot. Its total annual catch will therefore be

143,679,798,960 cubic feet.[1] The streams of the valley must expect to carry one-third of this bulk, i. e. a daily average should give the streams a supply of 131,214,428 cubic feet. A rainfall of six inches over the entire valley is a dreadful calamity, and that is not far from the estimate given of this flood. Experience with this valley shows with great certainty that the break-up of winter will be the annual occasion of great overflows. This year it reached a greater magnitude than ever before known. Let the estimate be one-tenth of its catch, 14,367,979,896 cubic feet, getting out of the valley in thirty days, or at the rate of 4,789,326,632 cubic feet a day. Now we have no power of handling this immense bulk of water after it gets in motion. But this is not all. This is the estimate upon clean water. It is very far from being that by the time it reaches the principal streams and the main river. Things that will come to the top are visibly floating in the shape of drift; things that will not waterlog, i. e. gravel and silt, are clogging the flow and filling the space it should occupy.

The bed of this river affords sufficient room for any supply of water to pass that ought to find access to it. Its lowest depth and narrowest width between Pittsburg and Louisville are to its highest and widest safe gauge as 1 to 1320. If this margin of expansion be not enough no digging or leveeing of human devising will long hold its floods in restraint. If we can reduce this variation in flow from 1 to 10, a great deal would be gained. A vast improvement to the useful purposes of the river if the variation between extremes were not greater than from 1 to 3. For illustration, say its lowest stage be 400, its highest should not exceed 1200 in cross section. If by well-placed catches averaging eighty acres to every 25,000 drained, having a vertical margin of from 7 to 10 feet between their low and high water discharges, that the one should not exceed the other more than ten times, we would I think find a solution of the troubles now besetting the drainage of the Ohio Valley.

The streams of the Ohio Valley have no storing capacity, but being narrow, deep, and for the most part of steep slope, they hustle their catch of water into the main stream with undue haste. Room should be found in the smaller streams and near the top of each watershed for storing its extreme catch, say a six-inch rainfall, so that all of it would not leave the watershed for thirty days. A 1,000 acre watershed in this valley would give a daily flow of 990 cubic feet. A 25,000 acre watershed twenty-five times that, 24,750 cubic feet, daily flow. Under the circumstances of the flood of 1884 the catch of the watershed would be 2,709,750 cubic feet, over 100 times its daily output. It should be made to stand upon the order of its going over sixty days, i. e. for sixty days the reservoirs should have an outflow of nearly twice the average for the year. Make the stream capable of delivering two and a half times the 24,750 cubic feet, with

1. Though this seems a great array of figures is it the smallest I can make. And I am sure that the larger figures would only make the demand more evident for handling the bulk in detail. One estimate of this total annual catch gives the vast bulk of 20,689,887,828,600 cubic feet. This would greatly increase the daily average; but either set of figures is vast enough to demand thoughtful consideration, and that too in the line indicated by the article.

a rate of current not exceeding six or seven miles an hour. These things would be gained: Time for the catch of the lower basins to get out of the way a little and freedom from the silt of the upper basin. As the streams are now the catch of the watershed of 25,000 acres goes out of the basin in five days, to the utter confusion of the streams and valleys below it.

If we begin with a careful survey of every watershed and at the head of every hollow build our way out for its catch of water and make its storage capacity equal to the demands that we find made upon it, we work with reasonable certainty of success. The water-supply is known by measurement as we come into the lower valley and the time that it will take to reach the main river. This calls for considerable land. Yes, eighty acres to every 25,000, yet that is not much more than is now rendered useless by these ungoverned streams and open drains. For the local utilities that may be wrought by a competent engineering of the watercourses, see article "Rural Engineering," Kansas City REVIEW for December, 1883.

The opening of land to cultivation has had a great influence in increasing the liability to floods and overflows in the valley of the Ohio. It was originally covered by a dense forest that gave up the rainfall to the streams much more slowly than open fields. Yet in 1832, before this forest had been much destroyed there was an overflow. It is not at all likely that this valley will ever be relegated to forest again. The suggestion given here and advised by the army officer would seem to lie within the power of our people to carry out. That Congress can do much, I doubt. That it ought to do something is manifest, for it is a matter of national importance; but the parties having the matter under their keeping are those units of our commonwealth, the town and the county. Congress has but few rights which a farmer, a county judge and a surveyor in Pennsylvania or West Virginia are bound to respect. And if these benefits are ever to come to the people of this beautiful land, they must come through their own action, under the watchfulness of those immediately concerned.

In addition to proper catch-ponds care is required by the streams. Neglect of them is sure to bring a penalty. The drain of the unit of area that we have taken, 25,000 acres, will be required under an inch of rainfall to carry 225,606 cubic feet. There should be no unnecessary obstruction to the passage of such a bulk. It should not be allowed to reach the stream in disorder, nor be thrown into disorder after getting there by a too great rapidity of current and accumulated drift and silt. There should be a penalty for fouling a stream. In uniting with other streams care should be taken that they meet in a reservoir or pool. It need not be large, but there should be room for settling of the waters so that the outlet would not be crowded. Four areas of 25,000 acres is a watershed that will give ample supply of water for many a useful industry. A daily flow of 99,000 cubic feet at a rate of three and a half miles an hour is a stream that will afford many a pleasant row, and drive many a mill. Especially if you can hoard a supply over night, and if you can measureably control its supply. Ten such areas under control will form a river of useful navigation if it receives in the same

line of drainage the catch of smaller watersheds, for a width of three miles each side of it.

Subjecting the tributaries of the Ohio River to such control would not be a difficult task for the engineer corps. Obtaining the consent of the people of that region, would be a much harder task for the politician. In his behalf allow me again to quote my statesman DeWitt Clinton: "Every judicious improvement in the establishment of roads and bridges, increases the value of land, enhances the price of commodities and augments the public wealth." The grand work of his life was the Erie Canal. The statesman who will do for the Ohio Valley the difficult but grand object, the complete control of its water-courses, in behalf of the safety, the welfare, the commerce, and the beauty of a most delightful land, will deserve the lone of a grateful people.

THE PANAMA CANAL.

Count de Lesseps, although now seventy-nine years of age, may live long enough to see the waters of the Atlantic and Pacific united by means of the great ship-canal across the Isthmus of Panama with which his name will be forever associated. Whether he is spared to witness the completion of this, his greatest work or not, he will take his place in history with Fulton and Franklin and the other great benefactors of mankind through whose genius the possibilities of commercial intercourse have been indefinitely enlarged.

The report of Lieut. Raymond P. Rogers on the progress of the work on the inter-oceanic canal, which the Secretary of the Navy sent to the Senate a few days ago, leaves little doubt but that this stupendous work will be completed during the present decade, and Count de Lesseps himself thinks that it will be ready for ships in four years. Lieut. Rogers is of the opinion, however, that the colossal cuts in the Culebra section cannot be made in so short a time. Although this section is only a mile and a quarter in length, nearly thirty-three million cubic yards of earth and rock must be removed.

Dredging out the harbor at Aspinwall and Panama and constructing basins and quays at each end of the canal constitute no inconsiderable part of the work. A new channel for the Chagres River must also be dug along a considerable portion of the route, so that for twenty-seven miles on the Atlantic slope there will be practically two canals—one for ships and one to drain off the water of the Chagres and its tributaries. Of course this adds immensely to the cost of the work.

On the Atlantic side the difficult part of the work is to drain off the superfluous water, and on the Pacific side to cut through the rocky hills. In some places the cuts will be sixty-two feet in depth and 117 feet wide at the top. The cost of excavation in these cuts is from fifty-seven cents to $1.53 per cubic yard. From Matchin to the Pacific, a distance of about fourteen miles, these costly cuts are quite frequent. The whole length of the canal is forty-five miles, but

the last two or three miles run along the shore of the Panama Bay, and the ship channel will be made by simply dredging out the Bay.

Although a Frenchman is at the head of this great work, and most of the capital is furnished by Europeans, yet American ingenuity is largely drawn upon for the active propelling force. Without the American dredging machines it would take so long to dig the canal that it would almost be impossible to raise the necessary capital, the possibility of earning dividends being too remote. With the American dredging machines the excavating is done with such rapidity as to bring the completion of the work within a reasonable period.

There are American dredging machines and steam excavators and American contractors all along the line. In some places a single one of these machines is throwing out earth at the rate of 5,000 cubic yards a day. Temporary railroads must be built at every cut, and, in fact, wherever it is necessary to carry the excavated material to a dumping ground. At the Emperador section, which is only three miles long, twelve locomotives are at work hauling away the earth thrown out by the excavators. In the Gorgona section an immense dam and reservoir are being constructed, which will receive the waters of the Upper Chagres.

About 15,000 men, mostly from Carthagena and Jamaica, are employed on the canal. The mortality among them has not been as great as was expected. The Europeans have suffered some from the climate. The rainfall at Aspinwall last year was 118.02 inches, and at Panama 36.62 inches. Twenty-five and a half inches of rain fell at Aspinwall in the month of August. Although he has no accurate information on the subject, Lieut. Rogers believes that $40,000,000 have been already expended on the canal. This is one-third of the estimated cost. Whether the remaining $80,000,000 will be sufficient to complete the work is problematic.—*National Republican.*

RIVER IMPROVEMENTS.

WM. H. MILLER.

The improvement of the Mississippi River is a subject in which the people residing in the valley of that stream have felt more or less interest from the time of the earliest settlement. The first effort in that direction was made at New Orleans within a short time of the first settlement there, and consisted of the construction of a short levee to prevent the inundation of the village by the annual floods. This form of improvement continued with a gradually increasing interest until the outbreak of the late civil war. After the Louisiana Territory became American possessions, and the settlement of the valley made the protection of the low lands more of an object and provided the wealth and population to prosecute such improvements, they were carried forward with greatly increased energy, and by State and local aid were pushed forward with such magnitude that by the year 1858 twenty-two hundred miles of levee had been constructed, ex-

tending along both sides of the river substantially from Cairo to the Balize, and covering all exposed and dangerous points except one reach on the west bank of the River in the New Madrid and St François River country of Missouri and Arkansas. With the outbreak of the war in 1861, these improvements stopped and much of that which had been made fell into bad repair during that struggle, and beyond some repairs little has been done at it since.

During the era in which these improvements were being made, the object most had in view was to protect the rich agricultural lands in the immediate vicinity of the river subject to inundation by annual floods. The river and its tributaries, the Missouri, Ohio, Illinois, Tennessee, Arkansas and the Red Rivers were all great channels of commerce, being navigated by steamboats which provided transportation for both passengers and freight. The steamboat was a very great improvement upon any method of transportation previously employed, but their expensiveness and inadequacy had not yet been shown by the competition of railways, hence the necessity of improving the navigability of the river had not made itself apparent. Soon after the close of the war this defect became prominent, railways extending from the Mississippi Valley to the Atlantic seaboard having diverted the course of commercial movements from the river channel.

As a remedy for this defect and to provide the cheaper transportation which water-courses afford Capt. James B. Eads, of St. Louis, proposed the improvement of the channel of the Mississippi so that it could be navigated with barge lines instead of steamboats, and the opening of one of the outlets into the Gulf, which constitute the Mississippi delta, so that the largest sea-going craft might enter into the deeper waters inside the bars. Under authority and by aid of the National Government this improvement was begun at South Pass, consisting of a system of jetties, to confine the water into a narrower channel and thus cause it to do its own dredging. The conclusion of this work was so successful in providing a sufficiently deep channel, and also in showing the practicability of such improvements on the river that it was then proposed to extend it to all shoal places along the Mississippi and its navigable tributaries. With this view the Mississippi River Commission was instituted by Congress for the Mississippi River proper, and able engineers of the Army were detailed to take charge of the improvements of the tributaries.

The first work to which the Commission and the engineers addressed themselves was the surveys of the river, geographically, hpdrographically, and hydrometrically, with a view of determining the extent of the improvement to be made, its ultimate cost and methods. These surveys having been completed, it was found that the Missouri River and the Mississippi below the mouth of the Missouri, was in character substantially the same stream, easy of improvement and requiring substantially the same methods. These two streams, as far down as Lake Providence at least, run through an alluvial and sandy soil. They have great fall and hence a rapid current, which rapidly cuts away the banks wherever

it strikes them, thus filling the water with sediment. The water striking one shore is deflected to the opposite, like the rebound of a billiard ball from the cushion. Being thus thrown from side to side, the water in making crossing has naturally less fall and a wide area of channel width over which to spread, thus forming shallow places or bars. This gives the river the appearance of a succession of deep pools between which intervenes a shallow. As was said by Hon. Robert S. Taylor, of Indiana, a member of the Mississippi River Commission, in an address before the Merchant's Exchange, of St. Louis, if the water could be lifted out of the bed of these rivers so that the true shape of the channel could be seen, it would be found to be a succession of deep hollows divided by high sand-hills, the ridge of the latter lying crosswise of the stream.

The problem of improvement for purposes of navigation thus resolved itself into two. The first consists of protecting the wasting banks and thus preventing the shifting of the channel, and by stopping the erosion to reduce the sediment. The second was to provide methods for narrowing the channel at the shallow places and thus causing the river to dredge them out itself and thus deepen the channel. The means adopted by the Commission in the Mississippi and by the engineers on the Missouri consists of a revetment of the wasting banks; that is to say a mattress-work of willows and other brush is woven with wire and spread along the wasteing bank from the bottom of the channel to the low-water mark. Above this the steep bank is sloped. So far as this means has been applied on the Mississippi it has proven efficacious. Whether it will do so in the more sandy soil of the Missouri and under the erosive action of its more rapid current does not yet appear to have been fully demonstrated. The means employed in the second case—the deepening of the shallow—consists of the construction of jetties similar in character to those employed at South Pass for the restriction of the water and to procure its scouring effects. This has proven efficacious in the Mississippi but has not yet been sufficiently tested in the Missouri. All who understand the stream, however, entertain a doubt of its efficacy, but the engineer in charge, Major Charles R. Suter, is sanguine that it will provide in the Missouri a minimum depth of water of twelve feet.

Another form of improvement required on the Mississippi, and perhaps on the Missouri also, consists of the closing of "chutes" or by-channels, at islands, so as to confine the water to one channel. This is done by driving piles across the heads of such channels and filling in between with brush up to the low-water level. This causes the river to form a bar in such channels below such works and thus with comparatively little work and expense, utilizes the river power to dam such channels. This has proven very efficacious in the Mississippi and can hardly do otherwise on the Missouri.

The cost of the whole improvement cannot now be definitely estimated. It was at first supposed that $40,000,000 or $50,000,000 would be adequate for the Mississippi, and Major Suter estimated the cost of the improvement of the Missouri at $10,000 per mile, making a total of about $8,000,000 for that part of the river between Sioux City and St. Louis. Whether such sums will be adequate

depends somewhat upon the way in which the appropriations are made by Congress. Much work has been done on the Missouri which has been found useless because the appropriations were so far short of the estimates for the locality to which they were applied that the work was insecure and washed away. True economy in this respect demands adequate appropriations, so that the work done may be completed and well secured between floods. It depends also somewhat upon the skill of engineers in estimating the strength and character of the works required to resist the powers of the river. The methods are to some extent experimental, and in some instances mistakes have been made, resulting in the loss of the works. Mistakes of this kind, in working upon a stream so little understood as this river, are inevitable but the experience so far had is a guide, and a guard for the future. These sums seem enormous, and the possibility that they may not prove inadequate makes people and Congressmen timid about entering upon a work involving such outlays. However, for a people who have given nearly two hundred million acres of land worth not less than twice these figures in money, and who have guaranteed bonds to the extent of over $100,000,000 more for Railroads such expenditures should not be alarming. It must be remembered that the object in the one case is the same as in the other—to provide transportation facilities for the people, as a means of increasing the prosperity of their industry. The Government having adopted the policy of making such improvements, and the results so far having fully warranted it, there should be no hesitation on account of the sums now required, provided it can be made clear that the results will justify the expenditure in this particular case.

The railroad system of the United States, constructed by private capital, is now very extensive, and is adequate to handle the products of the people. Why then spend so much public money to make this river improvement? Because it provides cheaper transportation for cheap, bulky products than the railroads now or ever can provide. This fact may be illustrated by a quotation of estimates contained in a memorial to Congress presented in 1882, by representatives of the Missouri River Improvement Association. These estimates took Kansas City as their initial point and the grain of the Missouri Valley alone as their base, and finding that the rail rate east of the seaboard was thirty-three cents per bushel on wheat and twenty-eight cents per bushel on corn, while the barge-rates to New Orleans, and additional ocean-carriage from New Orleans to Europe was fifteen cents per bushel, it was found that the water carriage offered a saving of eighteen cents per bushel on wheat and thirteen cents per bushel on corn. Finding then that the Missouri Valley country produced in 1879—the census year crop—61,117,379 bushels of wheat, and 414,379,526 bushels of corn it was found that the saving by the employment of water transportation would have been $64,865,229 for that one year alone. True, all the products of the valley would not have been thus moved, but since the price of grain in the Missouri Valley is the European price, less carriage and cost of handling, this sum would have been the value added to the products of our grains by the employment of water transportation. If we consider the extent of agricultural product in the

Valley of the Mississippi and its navigable tributaries, and apply to it such differences for one year only, the saving makes such enormous figures as to make the most extravagant estimates of the cost of the improvement appear quite insignificant. Indeed, the benefits derived from the aid granted railroads afford no comparison with it.

Another fact which bears strongly upon this branch of the subject is that the bulk of our exports consists of agricultural products. According to statements made by Hon. Joseph Nimmo, Chief of the Bureau of Statistics of the Treasury Department, products of agriculture made up $500,000,000 of our exports in 1882, while products of manufacture made up but about $103,000,000. And what is more inportant in this connection was the further statement of Hon. Joseph Nimmo that ninety per cent of this agricultural product came from the Western States, that is, the Mississippi Valley States, the other ten per cent being presumably the cotton of the Gulf States and the wheat of California, for the eastern and manufacturing States consume all their agricultural products and more.

Such being the facts in this case and such the benefits to be secured it seems that there should be no hesitation on the part of Congress to make the appropriation, especially since the treasury is in a plethoric state, and Congressmen are puzzled to know what to do with the money or how to prevent its accumulation without cutting off duties which would leave important industries to suffer. It certainly seems that there should be no hesitation on the part of the people, and that their duty to themselves clearly points to the demand that their members of Congress should make this river improvement a matter of paramount consideration, or give place to others who will do so.

ANTHROPOLOGY.

RELICS OF THE SANTA BARBARA INDIANS.

REV. STEPHEN BOWERS, PH.D.

Point Concepcion is 250 miles southeast of San Francisco. Here the shore-line of the Pacific trends eastwardly, and for the distance of nearly 100 miles runs nearly due east and west. Parallel with the shore-line and about thirty miles distant is a chain of islands, four in number, the smallest of which is but a few hundred yards wide and five miles long. The largest is twenty-two miles long by about five miles in width. The counties of Santa Barbara and Ventura, including the islands, embrace the territory in which lived what we may denominate the Santa Barbara Indians. Further out in the ocean are other islands once inhabited by Indians, but whether they belong to the Santa Barbara stock is not known.

Our first historical knowledge of these Indians dates back 342 years, or to the year 1543, when Cabrillo discovered this coast. He represents this portion of California as thickly populated with Indians, and somewhere not far from the town where the writer is living and dating this communication, he speaks of a large Indian town called by the natives, *Xucu*, but which he named De los Canoas, because of the great number of canoes owned by the Indians at that place. While anchored here two Indians came on board of one of his vessels and pointed out twenty-five Indian towns, the names of which Cabrillo records.

For 100 miles along this coast between Point Concepcion and Point Magu, the writer has examined about one hundred rancherias, or sites of old Indian towns. Back in the mountains and along the streams in the territory above mentioned they are also abundant, while the islands are literally covered with their shell-heaps or kitchen débris.

This genial climate and the abundance of food produced by land and ocean made this a desirable spot for the Indian, who is naturally antagonistic to labor. The sea yielded abundance of fish, mollusks and water-fowl, while the foot-hills and mountains contributed much game. In their shell heaps may be found every variety of mollusks now known here, prominent among which were edible clams and the ***haliotis***, all of which still exist along the sea-shore. The bones of whales, seals, sea-lions, sharks, black-fish, porpoises and many other fish are prominent in the old rancherias; also the bones of water-fowl, deer, bears, etc. This section was the Indian paradise of the Pacific coast. When the Jesuit Missions were founded here a century ago the islands and the mainland teemed with multiplied thousands of Indians, but now none are left to tell the story of their existence. They rapidly faded away before another form of civilization. Most that we can now learn of this race is obtained from their burial places, which were generally located in the midst of the village. They seemed to have had but one method of burial and that was to draw the knees up against the breast and place the face downward, burying one on top of another. In some places in a radius of a rod or less the writer has exhumed a hundred skeletons. These were found from one to four feet below the surface, and in some cases, six and even eight feet.

It is most likely that all the earthly effects of the individual were buried with the body, but only the stone, bone and shell implements and ornaments remain. In some rare instances the writer has discovered ornaments of redwood, which of all California wood is probably most durable. Coarse cloth has also been found with the skeletons. After the Missions were established the Indians were probably buried in the cemeteries of the priests, and it is not likely that burials have taken place in the rancherias later than seventy years ago. It is known that the last of the Indians were removed from the channel islands nearly seventy years since, yet thousands of skeletons have been dug up on these islands in a fine state of preservation, while the shells in the rancherias still retain their markings perfectly.

The relics found with the dead often show superior workmanship. Mortars

of sandstone were made by dressing the outside to the shape of a cast-iron kettle, such as are used for sugar or soap making, after which the block of stone was excavated, often leaving the sides little more than an inch in thickness in a specimen twenty inches or two feet in diameter. These mortars varied in size from a few inches to thirty inches in diameter, and were used in triturating acorns, etc., for food. The pestles were made of the same material and varied in length from five to thirty inches. They were made with much care, gradually sloping from the base to the smaller end, where there was often left a raised bead or knob, and sometimes two or three. Ollas or cooking vessels were carved out of crystalized talc and would hold from one to six or eight gallons. They were sometimes globular in shape and again bell- or pear-shaped, the sides thin and the mouth surrounded with a raised bead or ornamented with chevrons, or both. Some of these were as perfect as if turned in a lathe. Tortilla stones were made of the same material. They would average about seven or eight inches in length and width, but were in the shape of a keystone, and about one inch in thickness. A hole was drilled in the smaller end for handling them when hot. They were heated in the fire, and the dough being rolled thin was rapidly baked. Some who have eaten tortillas pronounce them very good.

But the most beautiful specimens are those made from serpentine. Cups, bowls, pipes, and many ornaments were made from this mineral. The cups and bowls were from about two to twelve inches in diameter, variously shaped, and sometimes with handles similar to the old fashioned skillet. Some of these described a perfect circle and were finely polished. The pipes were cone-shaped, varying in length from two to twelve inches. A bone mouth-piece was inserted in the smaller end and it was smoked cigar fashion. The ornaments were various but usually pendants. Most of the serpentines used contained seams of chrysolite, and when polished were very handsome. Some of the finest arrow-heads and spear-points I have ever seen were found in the burial places. They were manufactured from white and black chert, jasper, chalcedony and obsidian. I found one spear point manufactured from dark brown chert but one inch in width and over twelve inches long, very accurately made in every particular. Many most delicately finished arrow-heads with double barbs and indeed, a great variety of shapes have been found on the mainland and on the islands, which were probably used as ornaments in the hair and on different parts of the body. The wearing of them in the hair is referred to by Cabrillo.

In a burial place on the Santa Ynez River I exhumed some two hundred skeletons in a radius of about fifteen feet. With these occurred twenty-eight sandstone mortars holding from about two quarts to more than two bushels; forty-four pestles from a few inches to more than two feet in length, made of sandstone, polished and ornamented. They exhibited a great variety of finish, no two being exactly similar at the smaller end. There also occurred twenty ollas manufactured from steatite or crystalized talc, which were used for cooking vessels. They would hold from one to five or six gallons. This burial place yielded forty-four cups or bowls made principally from serpentine. I also found twenty-six

pipes which indicated the smoking propensities of this people. Also eight spear-points, twelve arrow-heads, one asphaltum jug, five cement cups made from the vertebræ of large fishes, twenty-four metal knives nearly destroyed by rust, six arrow-smoothers, ten tortilla stones. Besides these occurred stone knives and drills, bone whistles, a copper spear, charms, and tubes of stone and at least a half bushel of beads, wampum, ornaments of shells, bone and stone, a description of which would require a whole volume.

SAN BUENAVENTURA, CAL., March 4, 1884.

THE AZTECS.

CAPTAIN E. L. BERTHOUD.

Within a few years it has been a very common custom to call all the semi-civilized Indians of New Mexico, Arizona, and Colorado, Aztecs, and all the remains and ruined buildings of these Territories and States, Aztec fragments of former advancement. To a large extent we consider this nomenclature as a misnomer, and that on the best evidence obtainable there is no good proof of such affiliation.

Clavigero, in his "Historia Antiguade Mejico," tells us that from the most authentic accounts, traditions, and from other proof obtained by the earliest as well as later writers on the history of Mexico and its conquest by Cortez, that about the year 1160 of our era, the Aztecs, as a nation whom history has rendered famous, inhabited a place called Aztlan, a region which as shown on Mercator's Authentic Map of 1569, was situated north of the Gulf of California; Azt in the Aztec language signifying "water." That one Huitziton, a Cacique, chief or head man of that nation, once on a time evidently wishing to influence the nation to remove their local habitation, seems to have devised the following plan:

Noticing a sparrow (Pajarillo) that from a tree emitted a cry that sounded precisely as the Aztec word "Tihui Tihui," which in that language is in its meaning the same as the Spanish word *vamos*, "let us go," and informing another influential leader named Tecpaltzin of this phenomenon, the fact was interpreted by them to their nation as a warning from supernatural influences to guide their conduct. The Aztecs obeyed and began their wanderings, which lasted many more years than the Israelitish wanderings from Egypt to Caanan. They first went northeast, probably passing the great Colorado, then proceeded southeast to the Rio Gila, where they resided for a period, where yet the ruins of buildings can be seen; thence they wandered to latitude 29° about 250 miles northeast of Chihuahua. This place is known now as Casas Grandes, from a very large building which yet remains, having been erected by the Aztecs during their perigrinations.

From this place they turned south, crossed the Tarahuma Mountains, and

reached Hueiculhuacan, called to-day Culiacan, about 24½ South latitude. Here they remained three years. From this town they changed their course to the east; reaching Chicomozloe, supposed to be a town about twenty miles from Zacatecas, where yet is seen a large building erected by the Mexicans.

From Zacatecas, traveling south, they went to Colima, then turning east from Zacatula they lived in the mountains near Tuluca, thence they directed their journey north, reaching in 1196 the noted town of Tula.

They remained nine years in Tula, and then eleven more in other neighboring localities, reaching Zampanco in 1216, fifty-six years from their departure from Aztlan, remaining seven years in Zampanco; from Zampanco they went to Tizajocan, then to Tepeyac, then to near the shores of Lake Tezcuco near where afterwards was built the city of Mexico. Here they lived twenty years. Being much vexed here they moved to Chapultepec about the year 1243.

Here being attacked and conquered by the nation of Colhuacan, they were all enslaved about the year 1314. After aiding the Colhuans or people of Colhuacan to overcome the Joqumilcos the Colhuans, indignant at the human sacrifices of the Aztecs, for which prisoners of war were used, ordered them out of the country. The Aztecs pleased, traveling northwards, established themselves at Mexicaltzinco, a place between the two lakes. Here, the locality not suiting them, they removed farther from the Colhuans and passed to Iztalco, in close proximity to their future city of Mexico. Here they lived two years, finally settling on the spot where, seeing an eagle sitting or a nopal or cactus growing on a rock, they called the place Tenochtitlan, calling afterwards the city erected there Mexico, which was begun by human sacrifices in the year 1325, one hundred and sixty-five years from their departure from Aztlan. This then is the condensed story of their wondrous pilgrimage, which Betemcourt says was 2,700 miles in length.

How then can we, by any possible turn, bring our Aztecs, as some have tried, into Colorado, Arizona, and New Mexico, yes, even to the Mississippi River, in the person of the extinct Natchez, or even have transmuted the Mound-builders of the Ohio Valley and the Upper Mississippi into the Aztecs, who, driven out, went southwest into New Biscay, or Aztlan, thence to the lakes of Tezcuco, migrations of pure fancy; hypotheses founded on transcendental history.

The Pueblos of Arizona, New Mexico and Colorado worship the Sun and keep a sacred fire in an estufa. They have a tradition obtained from Spanish intercourse of a fabulous person called Montezuma. The serpent was also a sacred emblem, and we believe the Zunians have traces of former sacrifices. All are industrious, all have a *quasi* semi-civilization, and all know how to cultivate the soil and raise stock. On these points of similarity is the whole fabric built that makes them Aztecs by name, not by any direct act.

THE UPRIGHT ATTITUDE OF MANKIND.

Every one must have heard or have read of the supposed perfect adaptation of the human frame to bipedal locomotion and to an upright attitude, as well as the advantages which we gain by this erect position. We are told, and with perfect truth, that in man the occipital foramen—the aperture through which the brain is connected with the spinal cord—is so placed that the head is nearly in equilibrium when he stands upright. In other Mammalia this aperture lies further back, and takes a more oblique direction, so that the head is thrown forwards, and requires to be upheld partly by muscular effort and partly by the ligamentum nuchæ, popularly known in cattle as the "pax-wax."

Again, the relative lengths of the bones of the hinder extremities in man form an obstacle to his walking on all-fours. If we keep the legs straight we may touch the ground in front of our feet with the tips of the fingers, but we cannot place the palms of the hands upon the ground and use them to support any part of our weight in walking. Not a few other points of a similar tendency have been so often enlarged upon, in works of teleological character, that there can be no need even to specify them at present.

But till lately it has never been asked "Is man's adaptation to an upright posture perfect?" and "Is this posture attended with no drawbacks?" These questions have been raised by Dr. S V. Clevenger in a Lecture delivered before the Chicago University Club, on April 18th, 1882, and recently published in the "American Naturalist." This lecture, we may add, cost the speaker the chair of Comparative Anatomy and Physiology at the Chicago University!

Dr. Clevenger first discusses the position of the valves in the veins. The teleologists have long told us that the valves in the veins of the arms and legs assist in the return of blood to the heart against gravitation. But what earthly use has a man for valves in the intercostal veins which carry blood almost horizontally backwards to the azygos veins? When recumbent these valves are an actual obstacle to the free flow of the blood. The inferior thyroid veins which drop their blood into the innominate are obstructed by valves at their junction. Two pairs of valves are situated in the external jugular, and another pair in the internal jugular, but they do not prevent regurgitation of blood upwards.

An anomaly exists in the absence of valves from parts where they are most needed, such as the venæ cavæ, the spinal, iliac, hæmorrhoidal, and portal veins.

But if we place man upon all-fours these anomalies disappear, and a law is found regulating the presence or absence of valves, and, according to Dr. Clevenger, it is applicable to all quadrupeds and to the so-called Quadrumana. Veins flowing towards the back—*i. e.*, against gravitation in the all-fours posture—are fitted with valves; those flowing in other directions are without. For the few exceptions a very feasible explanation is given.

Valves in the hæmorrhoidal veins would be useless to quadrupeds; but to

man, in his upright position, they would be very valuable. "To their absence in man many a life has been and will be sacrificed, to say nothing of the discomfort and distress occasioned by the engorgement known as piles, which the presence of valves in their veins would obviate."

A noticeable departure from the rule obtaining in the vascular system of Mammalia also occurs to the exposed situation of the femoral artery in man. The arteries lie deeper than the veins, or are otherwise protected, for the purpose—as a teleologist would say—of preventing serious loss of blood from superficial cuts. Translating this view into evolutionary language, it appears that only animals with deeply placed arteries can survive and transmit their structural peculiarities to their offspring. The ordinary abrasions to which all animals are exposed, not to mention their onslaughts upon each other, would quickly kill off species with superficially-placed arteries. But when man assumed the upright posture the femoral artery, which in the quadrupedal position is placed out of reach on the inner part of the thigh, became exposed. Were not this defect greatly compensated by man's ability to protect this part in ways not open to brutes, he, too, might have become extinct. As it is, this exposure of so large an artery is a fruitful cause of trouble and death.

We may here mention some other disadvantages of the upright position which Dr. Clevenger has omitted. Foremost comes the liability to fall due to an erect posture supported upon two feet only. Four-footed animals in their natural haunts are little liable to fall; if one foot slips, or fails to find hold, the other three are available. If a fall does occur on level ground there is very little danger to any mammal nearly approaching man in bulk and weight. Their vital parts, especially the heart and the head, are ordinarily so near the ground that to them the shock is comparatively slight. To human beings the effects of a fall on smooth, level ground are often serious, or even deadly. We need merely to call to mind the case of the illustrious physicist whom we have so recently and suddenly lost.

The upright attitude involves a further source of danger. In few parts (if any) of the body is a blow more fatal than over what is popularly called the "pit of the 'stomach.' In the quadruped this part is little exposed either to accidental or intentional injuries. In man is quite open to both. A blow, a kick, a fall among stones, etc., may thus easily prove fatal.

Another point is the exposure and prominence of the generative organs, which in most other animals are well protected. Leaving danger out of the question, it may be asked whether we have not here the origin of clothing? The assumption of the upright posture may have made primitive man aware of his nakedness.

Returning to the illustrations furnished by Dr. Clevenger we are reminded that another disadvantage which occurrs from the upright position of man is his greater liability to inguinal hernia. In quadrupeds the main weight of the abdominal viscera is supported by the ribs, and by strong pectoral and abdominal muscles. The weakest part of the latter group of muscles is in the region

of Poupart's ligament, above the groin. Inguinal hernia is rare in other Vertebrates because this weak part is relieved by the pressure of the viscera. In man the pelvis receives almost the entire load of the intestines, and hence Art is called in to compensate the deficiencies of Nature, and an immense number of trusses have to be manufactured and used. It is calculated that twenty per cent of the human family suffer in this way. Strangulated hernia frequently causes death. The liability to femoral hernia is in like manner increased by the upright position.

Now, if man has always been erect from his creation,—or, if that term be disliked, from his origin,—we have evidently nothing to hope from the future in the way of an amendment of this and other defects. But if we have sprung from a quadrupedal animal, we have by degrees adopted an upright position, to which we are as yet imperfectly adapted, the muscular tissues of the abdomen will doubtless in the lapse of ages become strengthened to meet the demand made upon them, so that the liability to rupture will decrease. In like manner the other defects above enumerated may gradually be rendered less serious.

A most important point remains: the peritoneal ligaments of the uterus fully subserve suspensory functions. The anterior, posterior, and lateral ligaments are mainly concerned in preventing the gravid uterus, in quadrupeds, from pitching too far forward towards the diaphragm. The round ligaments are utterly unmeaning in the human female, but in the lower animals they serve the same purpose as the other ligaments. Prolapsus uteri, from the erect position, and the absence of supports adapted to that position, is thus rendered common, destroying the health and happiness of multitudes.

As a simple deduction from mechanical laws it would readily follow that any animal or race of men which had for the longest time maintained an erect position would have straighter abdomens, wider pelvic brims with contracted pelvic outlets, and that the weight of the spinal column would force the sacrum lower down. This, generally speaking, we find to be the case. In quadrupeds the box-shaped pelvis, which admits of easy parturition, is prevalent. Where the position of the animal is such as to throw the weight of the viscera into the pelvis, the brim necessarily widens, these weighty organs sink lower, and the heads of the thigh-bones acting as fulcra permit the crest of the ilium to be carried outwards, whilst the lower part of the pelvis is at the same time contracted.

In the innominate bones of a young child the box shape exists, whilst its prominent abdomen resembles that of the gorilla. The gibbon exhibits this iliac expansion through the sitting posture which developed his ischial callosities. Similarly iliac expansion occurs in the chimpanzee. The megatherium had wide iliacal expansions due to its semi-erect habits; but as its weight was in great part supported by the huge tail, and as the femora rested in acetabula placed far forwards, the leverage necessary to contract the lower portion of the pelvis was absent.

Prof. Weber, of Bonn, quoted in Karl Vogt's "Vorlesungen über den Menschen," distinguishes four chief forms of the pelvis in mankind,—the oval in

Aryans, the round among the Red Indians, the square in the Mongols, and the wedge shaped in the Negro. Examining this question mechanically, it would seem that the longer a race had remained in an upright position the lower is the sacrum, and the greater is the tendency to approximate to the larger lateral diameter of the European female. The front to back diameter of the ape's pelvis is usually greater than the measurement from side to side. A similar condition affords the cuneiform, from which it may be inferred that the erect position in the Negro has not been maintained so long as in the Mongol, whose pelvis has assumed the quadrilateral shape owing to the persistence of spinal axis weight for a greater time. This pressure has finally culminated in forcing the sacrum of the European nearer the pubes, with consequent lateral expansion and contraction of the diameter from front to back. From the marsupials to the lemurs the box-shaped pelvis remains. With the wedge-shape occasioned in the lowest human types there occurs a further remarkable phenomenon in the increased size of the fœtal head accompanying the contraction of the pelvic outlet. While the marsupial head is about one-sixth the size of the narrowest part of the bony parturient canal, the moment we pass to erect animals the greater relative increase is there seen in cranial size, with a co-existing decrease in the area of the outlet. This altered condition of things has caused the death of millions of otherwise perfectly healthy and well-formed human mothers and children. The palæontologist might tell us if some such case of ischial approximation by natural mechanical causes has not caused the probable extinction of whole genera of Vertebrates. "If we are to believe that for our original sin the pangs and labour of childbirth were increased, and if we also believe in the disproportionate contraction of the pelvic space being an efficient cause of the same difficulties of parturition, the logical inference is that man's original sin consisted in his getting upon his hind legs."

This subject is not without direct applications. Accoucheurs cause their patients to assume what is called the knee-chest position, a prone one, for the purpose of restoring the uterus to something near a natural position. Brown-Sequard recommends, in myelitis, or spinal congestion, drawing away the blood from the spine by placing the patient on his abdomen or side, with hands and feet somewhat hanging down. The liability to *spina bifida* is greatest in the the human infant, through the stress thrown on the spine. The easy parturition in the lower human races is due to the discrepancy between cranial and pelvic sizes not having been as yet reached by those races. The Sandwich Island mother has a difficult delivery only when her child is half white, and has consequently a longer head than the unmixed native strain.

At present the world goes on in its blindness, apparently satisfied that everything is all right because it exists, ignorant of the evil consequences of apparently beneficial peculiarities, vaunting man's erectness and its advantages, whilst ignoring the disadvantages.

The observation that the lower the animal the more prolific (not universally true!) would warrant the belief that the higher the animal the more difficulties

encompass its propagation and development. The cranio-pelvic difficulty may perhaps settle the Malthusian question as far as the higher races of men are concerned, by their extinction.

If the facts brought forward by Dr. Clevenger cannot be controverted, they seem to prove that man must have originated by gradual development from a four-footed being. Had he been created an erect, bipedal animal, as we find him, his structure would have been not in partial, but in perfect, adaptation to the conditions of that attitude. That some of the peculiarities of his structure are better in harmony with a horizontal than a vertical position of the spinal colum, is perhaps the strongest argument against the theory of direct creation and the radical *toto cælo* distinction between man and beast that has yet been advanced. We cannot at the moment lay our hands upon any thorough and trustworthy account of the valves in the veins of the sloth: as that animal spends its life hanging, back downwards, the structure of the veins would be interesting in this connection.—*London Journal of Science.*

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Owing to mistakes in copying the reports of temperature and pressure as given last month were erroenous and a corrected statement of these items is herewith given.

	Jan. 20th to 30th.	Feb. 1st to 10th.	Feb. 10th to 20th.	Mean.
TRI-DAILY OBSERVATIONS.*				
7 a. m	21.0	20.8	15.4	18.1°
2 p. m	39.3	34.9	29.1	33.1
9 p. m	29.5	25.9	22 1	24.9
Mean	27.7	26.8	22.17	25.4
PRESSURE AS OBSERVED.†				
7 a. m	29.152	29.054	28.984	29.063
2 p. m	29.228	28.985	29.978	29.064
9 p. m	29.145	28.974	29 008	29.042
Mean	29.175	29.013	28.991	29.059

* Temperature Corrections of Feb. Report. † Barometric Corrections of Feb. Report.

March has proved a cool month up to the date of this report and the signs of vegetation suited to spring are yet scanty.

Unusually high wind prevailed on the 10th and 11th, reaching a velocity

of over sixty miles per hour. The rains of the past ten days have brought the ground into fine condition for starting the grass and crops provided the weather shall be warm and without too much rain.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Feb. 20th to 29th.	Mar. 1st to 10th.	Mar. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	—1.	10.	20.	10.3
Max	76.	60.	61.	62.6
Min. and Max				
Range	68.	50.	39.	52.3
TRI-DAILY OBSERVATIONS.				
7 a. m.	22 6	19.8	31.7	24.70
2 p. m.	43.3	37.0	50.4	43.83
9 p. m.	31.3	26.9	38.6	32.27
Mean	32.4	29.9	40.2	34.17
RELATIVE HUMIDITY.				
7 a. m.		.82	93	.87
2 p. m.		.76	.89	.58
9 p. m.		.89	.95	.92
Mean		.82	.76	.79
PRESSURE AS OBSERVED.				
7 a. m.	29.020	29.019	29.014	29.018
2 p. m.	29.080	29.987	29.033	29.033
9 p. m.	29.070	29.032	29 067	29.056
Mean	29 060	29 013	29.035	29.030
MILES PER HOUR OF WIND.				
7 a. m.	25	16.7	23.7	21.8
2 p. m.	19	21.6	29.3	23.3
9 p. m.	9	18.4	20.3	15 9
Total miles	2890	4867	5914	
CLOUDING BY TENTHS.				
7 a. m.	6 0	8.8	6.4	7.1
2 p. m.	4.5	7.3	6.9	6.2
9 p. m.	4.4	5.7	5.4	5.2
RAIN.				
Inches	.00	.19	1.65	1.84

THE WEATHER OF THE PAST SEVENTEEN WINTERS.

PROF. F. H. SNOW, UNIVERSITY OF KANSAS.

The following table gives the chief characteristics of the past seventeen winters. During this period five winters have had a lower mean temperature and a larger number of zero days than the winter just closed, six winters have had a larger number of winter days, but only one has had a lower minimum temperature. The rainfall (including melted snow) of the past winter has been three-fourths the average amount; the fall of snow has been slightly above the average depth; the cloudiness has been more than two per cent above the mean; the wind has exceeded its average by more than 5,000 miles; there has been a single thunder-shower (the average number); there has been one more fog than usual; and the barometer has exceeded its average height.

Winter of	Mean Temperatures.				Min. Temp.	Max. Temp.	Winter days.	Zero days.	Snow, inches.	Rain, inches.	Thunder storms	Mean Cloudiness.	Miles of wind.	No. of Fogs.
	Dec.	Jan.	Feb.	Season.										
1867—68 . .	34.50	23.67	35.71	31.29	– 7.0	72.0	48	3	6.50		1	.	. . .	1
1868—69 . .	24.29	30.50	30.63	28 49	-16.5	65.0	58	5	25.25	6.47	1	48.11	. . .	6
1869—70 . .	29.92	29.43	35.42	31.59	– 4.0	69.0	36	2	8.50	1.57	0	49.83	. . .	7
1870—71 . .	28.70	28.86	35.30	30.95	-10.0	71.5	42	8	21.50	4.26	2	54.55	. .	6
1871—72 .	24.91	24.35	30.44	26.57	-12.0	61.0	53	11	14.50	2.11	0	47 63	. .	5
1872–73 . .	19.93	18.61	30.26	22.93	-26.0	62.0	61	17	30.00	4.76	1	45 78	35,293	3
1873—74	31.37	28.01	27.05	28.96	– 2.5	67.5	49	1	21.00	7.69	3	58 70	34,652	6
1874—75 . .	31.01	15.60	21.92	32.84	-16.5	55.0	72	14	11.50	2.09	1	50.77	34,364	2
1875—76 . .	39.35	34.70	37.80	37.28	– 5.0	74.5	34	2	0 25	4.48	3	43.16	43,057	2
1876—77 . .	23 60	25.60	39.65	29 62	– 9.0	66.0	50	6	14 00	2.40	0	44.60	27,959	3
1877—78 . .	44.43	33.97	40.22	39.54	7.5	68.0	15	0	3.00	8.12	4	53.19	28,042	0
1878—79 . .	23.05	23.49	34 06	26.87	-16.0	74.0	54	13	25.25	2.76	0	45.59	27,502	2
1879—80 . .	26.23	41.23	37.58	35.01	– 9.0	67.0	36	2	3.00	4.92	2	41.75	37,543	11
1880—81 . .	25 84	21.60	25.78	24 41	-12.0	61.5	64	6	24.00	5.37	0	55 62	35,995	8
1881—82 . .	40.10	32.68	41.65	38.14	5.0	73.0	17	0	5.00	3.26	0	50.82	36,259	5
1882—83 . .	31.25	19.65	27.92	26.27	-14.0	67.0	57	9	14.50	4.28	1	55.61	34,366	8
1883—84 . .	33.72	20.99	28.03	27.58	-21.5	63.0	50	8	16.00	3.18	1	47.33	39,790	6
Mean . . .	30.13	26.64	32.91	29.90	-10 8	66.9	47	7	14.34	4.23	1	49.57	34,568	5

WEATHER PROVERBS.

S. A. MAXWELL.

A copy of Signal Service Notes, No. IX, "Weather Proverbs," lies before me, and in looking it over I am by turns amused, instructed, and disgusted; amused as Heraclitus used to be at the follies of mankind, disgusted as Sam Johnson was, by popular ignorance, and instructed when I find a truth hidden away like a pearl in a heap of refuse shells.

I do not criticise either the book or its author; since, as I understand, the compilation was made merely with a view to condense in book form all the weather-sayings of the peoples of different ages and nations, omitting nothing on account of its absurdity. My purpose will be to explain the cause or causes of certain phenomena taken as storm-forecasts, and also to prove the falsity of others too frequently relied on as infallible.

In the very able paper by the Hon. Ralph Abercromby with which Part I of the book begins, I find some statements which at least suggest the following explanations. He speaks of the "winds backing around in front of a depression to the south from the southwest," just as if this was what it really *does* do, when in fact it must move in the opposite direction, viz: from southeast to southwest, since the areas of barometric depression move almost invariably in an easterly direction, both in this country and in Great Britain. A curious fact concerning the winds about a storm-centre is this, that, of two places on the same latitude

the one the farthest west will first experience an east wind on the approach of a storm-area.

"A good hearing day is a sign of wet;
Much sound in the air is a sign of rain."

Why? Is it not because in a rainy time, the air moves in different currents with different densities, on account of which the vibrations are not readily transmitted upward, but are confined to the lower stratum of air? The lower stratum would not be altogether unlike a drain-tile tube through which a mere whisper can be heard fifty yards. I would not consider Tyndall's theory that audibility was due to the homogeneity of the atmosphere, but to the reverse, unless we are to understand the word horizontal before homogeneity.

The sound of thunder and of the firing of heavy cannon is not conveyed so much through the atmosphere as through the very crust of the earth, and hence the proverb applies less to sounds of this character, than to others of less intensity.

In Mr. Scott's discussion of the above named paper, he said that no one had as yet been able to forecast the amount of rain that would fall at a given place on a given day, and that inability to do so was apparently owing to ignorance of the conditions of the upper atmosphere. Now it must be conceded that for any area, say for 500 square miles, having equal length and breadth, in a level country like northern Illinois, the conditions of the upper air must be uniform in clear weather, and yet a storm may occur in one portion of such an area, and rain fall to a depth of two or three inches, while other parts are for the time rainless. Hence it would seem that our ability to foretell the *amount* of daily rainfall would not be enhanced by knowing the conditions of the upper air.

Mr. Abercromby states that the ice-film which forms the cloud in which the halo is formed is only produced *in front* of cyclones or thunder-storms, and for that reason is a sign of rain. The fact is, the halo is formed whenever the rays of the sun or moon are intercepted by the ice-film and may be *before* the storm-cloud, *after* it, or a thousand miles from it. Almost any of the cirri or cirro-strati will exhibit the halo, its brightness depending upon the number form, arrangement and movement of the frost-crystals composing the cloud.

"Anvil clouds are very likely to be followed by a gale of wind." Now what are meant by "anvil clouds"? I am sure I do not know. There are frequently seen in summer along the horizon, clouds the shape of which very perfectly represents the form of an anvil, and these are probably referred to. These clouds are small thunder-showers from fifty to one hundred and fifty miles distant and deserve especial study. One may learn by watching these clouds how the "horn" of the anvil always points forward, and how after dark the lightning will gild, not this part, but the rear and sides of the cloud, and also, by assuming the distance, we may tell the velocity of the storm. When one sees a cloud of this type he may know of a certainty that the storm, or more properly shower, will not pass over his locality, since it takes the direction that the anvil

points, hence it would be hard to see why these clouds indicate a "gale of wind." To an observer in front of such a cloud there is no anvil form at all; the "horn" not forming any part of the outline of the cloud. This form of cloud is developed when the ascending currents carry the clouds into strata of air moving more rapidly than those below. At first the cloud is but slightly leaned forward, but by and by the "fan cloud" spreads out from the top, and moves rapidly forward. It is the cirro-stratus in its first stages, though the margin is often a cirrus. It is this cloud that produces the halo before the snow-storm, as a rule, but rarely before a storm in summer, as it then has too great density. The typical anvil cloud in this locality, is rarely seen except in the north or south, with the point extending eastward.

"If you see a cloud rise against the wind, when that cloud comes up to you the wind will blow the same way that the cloud came." This shepherd-proverb, like the ordinary rules for spelling, is seriously hampered by "exceptions." It applies only to the thunder-storms of summer, not to any storms of the other seasons. The great rain- and snow storms of winter and spring come up from the southwest during the prevalence of easterly winds, which do not change for hours, possibly days, after the storm begins.

"Black clouds in the north in winter indicate approaching snow." If by this is meant a *bank of black clouds* then I would say that in all my experience I never knew the rule to hold good. A bank of clouds in the southwest in winter gradually darkening toward the horizon, is a very good indication of a snow-storm when there is an easterly breeze and the mercury ranges from 15° to 30° above zero.

> "If clouds be bright 'twill clear to-night,
> If clouds be dark, 'twill rain you hark."

Reference is probably made to the appearance of clouds in the evening after a heavy rain, when the Sun shines up under the edge of the cloud and gilds its base. This would not be so very bad,—the proverb would doubtless turn out right at least fifty one times in a hundred.

> "If the woolly fleeces strew the heavenly way
> Be sure no rain disturbs the summer day."

If the first clouds, cumuli, which condense in a summer morning, are light colored above and dark beneath, it indicates heat, and the chances for rain are good; but when the morning cumuli are dull and uniform in color, it signifies cool weather and no rain. These are among the most reliable indicators of the weather that I know of, and taken in connection with the direction of the wind one can forecast the weather for twenty hours in nine cases in ten correctly. I might say further that clouds that are absorbers of sunlight are signs of fair weather and those that are good reflectors are signs of foul weather. The reason for this is evident,—the denser the cloud the better reflector it forms and the more nearly does it approach a saturated condition. The reason that cumuli

sometimes have their bases flattened is on account of the different temperatures of the several strata of air. The stratum immediately beneath the cloud being warmer than the one in which the cloud floats, has a greater capacity for absorbing watery vapor, hence this remains invisible and the form of the cloud in the stratum above is modified accordingly.

"Clouds floating low enough to cast shadows on the ground are usually followed by rain." Nonsense. All clouds of any magnitude or density cast shadows in the daytime and the most brainless originator of weather proverbs ought to know it.

"One Saturday change of the moon is enough, as it is always followed by a severe storm." According to this whenever the moon changes on Saturday a large portion of the earth must be swept by severe storm, since the moon changes over a large part of the earth usually on the same day. This of course does not tally with the facts observed,—some portions of the earth never having severe storms at all, and when severe storms do occur they extend but a comparatively short distance. But I had not intended to speak of this class of proverbs, since no person of intelligence puts the least faith in such as refer to special days of the week or the year.

"If rain commences after nine it will rain next day." From this we must assume that if it commence before nine it will *not* rain the next day. Suppose a storm moving east reaches Lawrence, Kansas, at eight, Kansas City at nine, and Independence, Mo., at ten, then by this proverb the track of this storm, east of Kansas City, must on the day following be drenched with rain, while the portion westward must "go dry."

"Rays of sun appearing in a cloud forebode rain." With regard to this phenomenon, commonly called the "sun's drawing water" the author says, "This phenomenon is, in fact, caused by the image of the sun being reflected in an intervening cloud, the reflected image radiating in the cloud" This is all a mistake. As I stated in an article in the REVIEW some two years ago, this phenomenon is caused when the sun shines through rifts in the clouds,—the light streaks being produced by light reflected from particles of vapor exposed to sunlight. The dark lines of course are the parts shaded by clouds. These lines are generally seen when there is a background of dark clouds. Lines quite analogous to these are produced when sunlight enters a dark room through a slit in the blinds. The dust floating in the air takes the place of the watery vapor as the reflecting medium. Sometimes streaks of alternate light and dark sky are seen extending from the horizon at the point where the sun has just set, to the opposite point, and these are caused by clouds still below the horizon, their shadows giving rise to the dark lines, the light being produced by the sunlit portions. Since these shadows extend often from one hundred to two hundred miles, it shows that the clouds producing them must be large and sharply defined. Generally, the lines are produced by storm-clouds, hence their appearance may well be said to indicate an approaching storm.

So much for weather proverbs. It is to be hoped that these old sayings

will nearly all be forgotten in the good time coming, when instead of placing dependence on musty old rhymes of nonsense, people will learn the few general laws of storms, and with a little additional knowledge which observation alone affords, be able to forecast for themselves with all needful accuracy the changes to which the weather of our latitudes is ever subject.

MORRISON, ILL., March 10, 1884.

ASTRONOMY.

CELESTIAL PHENOMENA FOR APRIL, 1884.

PROF. W. W. ALEXANDER, KANSAS CITY, MO.

There will be visible in the evening during this month seven, or all, of the principal planets in the solar system. To begin with Mercury (the first in order of distance from the Sun,) it may be seen from the 20th until about the 30th in the western sky, from 7:30 to 8:45 by our standard time, its position will be 20° north of west at the time it sinks below the horizon. The point on the horizon at which it will set on the 29th exactly coincides with the place of sun-set. This elongation will be rather more favorable than usual for seeing it, from the fact the position of the Earth with reference to this planet's orbit enables us to observe it at a much greater distance from the Sun than usual. On the 25th it will be nearly 21° east from the Sun.

VENUS.—A description of the position of this planet is almost unnecessary; even the most casual observer cannot fail to notice it if he should take a glance at the western sky; it is by far the most brilliant object to be seen except the Sun or Moon. During the whole time its light will be increasing, from the fact that it will be rapidly approaching the Earth, being some thirty millions of miles nearer by the end than on the first of the month; it will be bright enough at any time to be seen with the naked eye in the daytime, it will be on our meridian about three hours after the Sun, or at 3:20 P. M. standard time, and at an elevation of 76°; this is a very high elevation being only 14° south of the zenith. It will be moving rapidly eastward across the heavens reaching conjunction with Saturn on the 12th, it will pass to the north 4° 13′. It also has a decided motion northward, it will enter the constellation Taurus on the 3d and by the 6th it will be nearly in line with Aldebaran, Saturn and the Pleiades. Aldebaran is a bright red star of the first magnitude and the only bright one in this constellation.

The above conjunction will aid in locating Saturn the next in order from west to east across the sky; this planet will not be favorably situated for observation this month, and therefore will not present us with any facts worthy of

note. By the last of the month it will be near the Sun and only visible for a few minutes during the evening twilight.

JUPITER and Mars will be close together on the 1st and both will pass the meridian in the evening twilight. The first to pass will be Jupiter, at 7:24 P. M. followed by his ruddy companion in forty minutes; their elevation at transit will be 72°, both are decreasing in size and brilliancy. The moons of Jupiter will be a very attractive feature of this planet's phenomena during this month; over forty transits, occultations, eclipses, etc., will be visible at different times from Kansas City.

URANUS will be in a fine position for evening observers; it will be in R. A. 11h. 44m. on the 1st, declination north 2° 33′, it will retrograde 4m. in R. A. during the month. On the evening of the 7th the Moon will be a few degrees south of this planet.

NEPTUNE will be very close to the Sun, too near to be observed. It will be occultated by the Moon on the 26th.

The Moon will pass 5° south of Mercury on the 26th at 8:00 o'clock in the evening, the evening of the 27th will find her near Saturn; the 28th near Venus, and the 30th Jupiter, and the next evening Mars.

VELOCITY.—I.

EDGAR L. LARKIN.

If a mass be let fall, it will be found at the end of one second to be moving with a velocity of 32.106 feet per second. Since gravity causes the motion, this velocity becomes a measure of the earth's attraction. The force of gravity on the surface of a sphere is equal to the quotient of its mass divided by the square of the radius. The mass and radius of the earth are each equal to 1; the mass of the Sun is 333,426 and radius 109.44. Hence,—for respective gravities on the earth and sun:

The Earth, =1 divided by the square of 1=1÷1=1.

The Sun, =333,426 divided by the square of 109.44=333,426÷11,978=27.836516.

Therefore,—a stone dropped on the sun's surface will acquire at the close of a second, a velocity=32.106×27.836516=893.75 feet=.16927 of a mile per second. This falling velocity is that motion generated in bodies let fall from an elevation not exceeding a few miles from the solar surface.

The question arises, how great velocity would be displayed by masses approaching the sun from immense distances such as planetary distances. One might ask with what velocity would a cosmical mass make impact on the sun upon arrival from some solitude beyond the solar system, say from a space half way to the nearest star, or 10 trillion miles. Since imagination has no limit,

why not inquire with what motion a mass would strike the sun that had fallen from an *infinite* distance, or what is the same, had been falling forever! This motion can be readily computed because the intensity of solar gravity is known, and it is also known what gravity is required to evolve any given rate of motion. Terminal velocity must have a limit even if the mass fell an infinite distance, since no force can exceed itself, an expression which may be given thus:—the attraction of the sun cannot cause greater velocity than it is able—if such statements fall within any rule of logic. The utmost motion that can be imparted by the sun to a body reaching its surface is equal to the square root of the product of twice the sun's gravity multiplied by its radius. Twice gravity= .16927×2=.33854×433,197=146,682 whose square root=382.95607 miles= 2,022,008 feet per second. It is with this appalling velocity that a cosmic mass will strike the sun on arrival from infinite distance!

This is one of the most important constants discovered by astronomers; by its use, many problem wherein gravity, space and motion are factors can be solved without extended computation, and in this note it will be made equal to G.

Having found final velocity from infinite distance, it is easy to determine terminal motion from finite distance.

From finite,—the velocity is equal to G multiplied by the square root of the quotient obtained by dividing twice the distance less 1, by twice the distance. This comes from the fact that the velocity of a body approaching the sun is at any instant equal to a constant velocity multiplied by the square root of the space fallen through, divided by the square root of the distance between the body and the centre of the sun. Let us find velocities of collision with the sun of masses that fall from several finite distances. We will call these distances r, and express them all in terms of the solar radius.

Take r=1, that is—a distance=the sun's radius or 433,197 miles from its surface. From the formula we have—square root of twice 1 less 1 divided by twice 1=square root of 1÷2=.7071065×G=270.79 miles=1,429,776 feet per second. That is, a stone taken into space a distance equal to the radius of the sun and let fall will strike the sun with this velocity. But 382.95607÷270.78= 1.414213 which is an important number because it is the square root of 2. We have arrived at the fact that,—velocity of fall from infinite space, is to velocity of fall from a distance equal to the radius of the sun, as the square root of 2 is to 1; i. e. as 1.414213 is to 1—only 40 per cent greater. This 270:79 miles velocity seems to possess peculiar properties; and the thought arises, may it not be found by other processes? Making trial we find that 433,197×.16927=73330 whose square root=270.79 miles.

But, here we multiplied the radius of the sun by the force of gravity and secured the same result by taking the square root of the product. From mechanics, we know that the radius of a revolving sphere multiplied by the intensity of gravity on its surface, equals the square of the velocity with which its equator must revolve in order that centrifugal tendency generated by such velocity of

rotation will equal gravity. Therefore, a stone on the equator of the sun will not loose its weight until the revolution of the sun reaches an equatorial velocity of 270.79 miles per second, a velocity 224 times more rapid than it has. Whence it appears,—that a mass reaching the sun from a fall through a distance equal to its radius acquires velocity equal to a velocity of rotation sufficient to evolve centrifugal tendency equal and opposite to the sun's attraction. But 1.414213÷2 =.7071065×G=270.79 miles; therefore the velocity generating power of solar gravity exerted within a distance from its surface equal to its radius is about 70 per cent of the entire amount exerted throughout infinite distance.

Having velocity of impact from infinite space and from one radius of the sun in distance, let us learn terminal motions from other finite terms of solar radii.

Here is a table of velocities generated by falling bodies at instant of collision with the sun from several distances all computed from above formula which we repeat to make familiar. For 2r, we find—square root of twice 2 less 1÷by twice two=square root of 3÷4; for 3r, square root of twice 3 less 1÷by twice 3 =square root of 5÷6, and so on.

Column I gives distances from the sun's center, II the squares of velocities, III the square roots of the numbers in II which roots are the velocities of impact expressed decimally, and require to be multiplied by G to find the figures in IV, which are real velocities in feet per second:

I. Distances from the Sun.	II. Squares of Velocities of Impact.	III. Square roots of II or velocities Decimally.		IV. Final Velocities at Collision.
r	.5	.7071065	×G =	1,429,776.
2r	.75	.866	×G =	1,751,039.
3r	.833	.9128	×G =	1,845,689.
4r	.875	.9358	×G =	1,892,195.
5r	.9	.95	×G =	1,920,908.
10r	.95	.9746	×G =	1,970,649.
100r	.995	.997	×G =	2,015,942.
200r	.9975	.99875	×G =	2,019,481.
214r	.997668	.9988325	×G =	2,019,647.
1,000r	.9995	.99975	×G =	2,021,502.
2,000r	.99975	.99987499	×G =	2,021,755.
6,440r	.9999146	.99995724	×G =	2,021,921.
10,000r	.99995	.99997499	×G =	2,021,957.
100,000r	.999995	.999997499	×G =	2,022,003.
1,000,000r	.999995	.9999997499	×G =	2,022,007.
10,000,000r	.9999995	.99999997499	×G =	2,022,008.
20,000,000r	.999999975	.999999997499	×G =	2,022,008.

This table demonstrates vividly the law that gravity varies as the inverse square of distances; and that velocities are as the square roots of spaces trav-

ersed. Because gravity varies inversely as the squares of distances, a limit is reached where increase of distance fails to have effect in accelerating terminal velocity. That limit as may be seen is a distance equal to about 1,000,000 solar radii, for an increase of 9,000,000 radii adds only one foot per second to terminal motion. If a mass be let fall at a distance of 20,000,000, it will reach the sun with the same velocity within a fraction of a foot per second as though dropped at a distance of 10,000,000 radii of the sun.

This is clear—for if 2,022,008 be multiplied by .99999999 the product is equal to itself; no change being produced in the product if we increase the number of .9s to infinity. This is equivalent to the assertion that 1 is the limiting velocity of fall on the sun i. e. 382.95607 becomes 1; from the principle that any constant can be made unity. We make the solar constant equal to one, when column III gives less velocities in regular progression.

In the table—214r, is the earth's distance, hence, a mass falling on the sun from a distance equal to that of our world will strike it with a velocity only 361 feet less than if it had fallen from an infinite distance.

The distance 6440r, is that of Neptune, whence, a mass will dash on the sun with but 87 feet less velocity than if it had been falling forever; while 20,000,000r, or in round numbers 10 trillion miles, represents half the distance to Alpha Centauri the nearest star. A stone let fall at a distance from the sun of 10 trillion miles will plunge into its fiery wastes with the same velocity it would have acquired had it been falling since the universe was made. Gravity at any distance from the surface of a sphere is equal to gravity on its surface divided by the square of the given distance. Since we expressed solar gravity in terms of velocity i. e. 893.75 feet or 10,725 inches per second, we can find the velocity of a falling body at any distance at the end of the first second of its fall. If we square 20,000,000 and divide 10,725 inches by the square, the quotient will be .000000000268 of an inch per second velocity that a falling body will acquire at the close of one second at a distance of 10 trillion miles, a velocity such that a mass moving at that rate will require 1,182 years to fall 1 inch. In these researches we find velocity infinitely slow and rapid. If we make the limit of distance one-half that to the nearest sun, then initial and terminal motion will lie within the limits of .000000000268 inch and 382.95607 miles per second. And it is by such calculations as these that we hope to learn something of the sidereal structure. We have considered the most simple variety of motion—that on a straight line; but before we can comprehend all is in the great subject of velocity we must make computation of other modes of motion, such as that displayed on ellipses, parabolas and hyperbolas.

NEW WINDSOR, ILL., March 13, 1884.

BOOK NOTICES.

THE UNITY OF NATURE: By the Duke of Argyll. Octavo, pp. 571. G. P. Putnam's Sons, New York and London, 1884. For sale by M. H. Dickinson, $2.50.

This work is to some extent a sequel to the author's admirable discussion of "The Reign of Law," published first in 1866, inasmuch as in that volume he expressed an intention of following the chapter upon Law in Politics by one upon Law in Christian Theology. When, however, he came to reflect upon the magnitude of the subject he speedily discovered that not only could it not be treated in a single chapter but that a whole book would be insufficient for the purpose without extended preliminary study and investigation. The object of the present work, therefore, is "to trace the connection between the reign of law and the ideas which are alike fundamental to all religions and inseparable from the facts of nature." The author proposes in this volume to offer a solution of some of the problems which perplex us most in this inquiry, through the scheme of the unity of nature, assuming that if these problems are not entirely soluble in this light, they are at least broken up by it and are reduced to fewer and simpler elements. "He says, "The following chapters are an attempt to follow this conception along a few of the innumerable paths which it opens up, and which radiate from it through all the phenomena of the universe, as from an exhaustless center of energy and of suggestion."

In order to give the reader a somewhat full idea of the comprehensivess of the work, we call attention to the titles of the thirteen ample and exhaustive chapters which are comprised in it, viz:—General Definitions and Illustrations of the Unity of Nature—What it is and What it is Not; Man's Place in the Unity of Nature; Animal Instinct in its relation to the Mind of Man; On the Limits of Human Knowledge; On the Truthfulness of Human Knowledge; On the Elementary Constitution of Matter in Relation to the Inorganic; The Elementary Constitution of Matter in Relation to the Organic; Man as the Representative of the Supernatural; On the Moral Character of Man; On the Degradation of Man; On the Nature and Origin of Religion; On the Corruptions of Religion; Recapitulations and Conclusion.

As will be seen by our readers the scope of this treatise is vast, and the student of it will wonder at and be impressed by the extensive knowledge displayed by its author. In the consideration of the various branches of the subject every department of knowledge is drawn upon with equal readiness and accuracy, whether it be physics, chemistry, biology, physiology, history, logic or metaphysics, while the summing up in the last chapter is able, forcible, and apparently unanswerable. The style of the author is clear, simple and logical, and

his treatment of the subject fair and candid. A copious table of contents and a complete index are not the least valuable portions of the work.

DISEASES AND INJURIES OF THE HORSE: Compiled and Edited by F. O. Kirby. Illustrated; octavo, pp. 332. William Wood & Co., New York, 1883. For sale by M. H. Dickinson.

This is one of the volumes of Woods' Library of Standard Medical Authors, and for owners of horses and veterinary surgeons it will be found eminently useful. It is a practical manual, prepared by the compiler after sixteen years experience of the diseases and injuries of the horse, and it is copiously illustrated with colored plates and wood cuts showing various forms of diseases, the instruments for and manner of treating them. The very best writers upon the subject have been freely drawn from and it is now offered as better adapted to the wants of horsemen than any work that has preceded it. It is handsomely printed and bound, thus being alike creditable to writer and publishers.

WHAT I SAW IN EUROPE: By S. O. Thacher. 12mo., pp. 153. Kansas Publishing House, Topeka, Kansas, 1883.

In the summer of 1883 Judge Thacher and family made a vacation excursion through Spain, Portugal, Tangier and southern France, afterwards returning through the more usually travelled route *via* Italy, Switzerland, Germany, the British Isles, etc. This volume is made up from the letters written by him to the Lawrence *Journal*, from time to time, and is published, not for sale, but for the entertainment and gratification of his friends. The author is a close observer, and though his trip was necessarily hasty, he found time to see and note much that is not the regular stock in trade of cicerones and guide-books. We have only space to say that the work is written in a free, flowing style and a genuine Kansas (which means cosmopolitan) spirit. The impression produced on his mind is summed up as follows: "There are few if any aspects of our life, our habits and institutions that do not excel those found abroad, while the elasticity, the freedom and noble equality of American citizenship compel even foreigners who once lived in the United States to unite with the returning traveler in his laudation of the land where there is no vast standing army, no titled aristocracy, no entailed estates, no State-paid priesthood and no barrier between the lowliest birth and the loftiest position."

VAGABONDIA:—A LOVE STORY: By Frances Hodgson Burnett. 12mo., pp. 392. Jas. R. Osgood & Co., Boston, 1884. For sale by M. H. Dickinson.

This is a reappearance of "Dolly," published in 1873 by Peterson, but revised, corrected and re-christened. It is a story of a family of artists and governesses, straitened in circumstances but contented with their lot and happy in

the society of other artist and writers in London, whose careless, jovial and improvident methods furnish the title of the book. "Dolly," who is the chief heroine and most brilliant member of the family, is engaged to a newspaper writer, named Griffith, who is smart, shabby and jealous. She is invited, as an attraction, to an evening party given by the rich Lady Augusta, where she meets Mr. Ralph Gowan, whom Griffith had described to her as "a complacent idiot in a chronic state of fatigue," but whom she found to be a gentleman of education and taste, and who was particularly attracted to her. Mr. Griffith becomes insanely jealous without cause, which condition is greatly aggravated by certain accidental complications growing out of an ill-advised love affair of sister Mollie's in which Dolly and Mr. Gowan figure suspiciously to him, and disappears, leaving Dolly to become ill almost unto death. Gowan sees through the trouble and generously searches Griffith out just in time to save Dollie's life, discovers that Mollie is, after all his fate: rich relatives opportunely come to the relief, all marry appropriately and settle down in comfortable affluence, etc. Around this meagre plot a very readable story is woven, perhaps not fully equal to some of Mrs. Burnett's later productions, but yet interesting and brilliant enough to absorb the attention of almost any reader for a few hours very pleasantly.

THE RESOURCES OF THE ROCKY MOUNTAINS: By E. J. Farmer. 12mo., pp. 190, flexible cloth. Leader Printing Company, Cleveland, Ohio. For sale by M. H. Dickinson, $1.00.

Mr. Farmer has put a great deal of useful information upon the mineral, agricultural, grazing, timber and other resources of Colorado, Utah, Arizona, New Mexico, Wyoming, Idaho, Montana and Dakota, into this little book. To the people of the West, who are so abundantly supplied with hand-books, guide-books, etc., by the various railroad companies whose lines lead thitherward, it may not seem to "supply a long felt want," but it may be of use to Eastern readers to know that it is regarded here as reliable and accurate. It contains a well ar ranged compilation of valuable information drawn from authentic sources and is very cheap at the price asked for it.

THE WORDS OF CHRIST: By John Bascom. 12mo., pp. 220. G. P. Putnam's Sons, New York, 1884. For sale by M. H. Dickinson, $1.50.

President Bascom, as writer and lecturer, has placed before the public some eight or ten volumes which have elevated him to a high rank among modern thinkers, and this work will strengthen that position, at least with the orthodox readers of the day. It is an effort to turn attention, quietly, fairly and considerately, but directly, to the words of Christ, as holding the theory and the only sufficent theory of spiritual growth, the force, and the only sufficient forces wherewith to secure that growth. As the author says, whatever else may be doubtful it is not doubtful that the spirit of the Gospels is the regenerative power of the

world. In the measure in which this is seen to be true will all doubts and difficulties take a secondary and remote position, and the path of life and the promises of life lie plainly before us."

The subject is discussed under the following heads: Personality in the Words of Christ; Rationality in the Words of Christ; Spirituality in the Words of Christ; The Law of Truth; the Law of Love; The Law of Consecration; Individual Growth; Social Growth; Growth of Society, Historically; The Natural and the Supernatural.

We commend the work to all calm, dispassionate, earnest truth-seekers.

OTHER PUBLICATIONS RECEIVED.

Reports on the Meteorology of Oakland, Cal., for 1882–3, J. B. Trembley, M. D. Report on Wind-Velocities at Lake Crib and Chicago, H. A. Hazen, Government Printing Office. Vibration of Rain-fall West of the Mississippi River, H. A. Hazen, Government Printing Office. Study of Meteorology in High Schools of Germany, Austria and Switzerland, Frank Waldo. Report on Lady Franklin Bay Expedition of 1883, by Ernest A. Garlington, Signal Office. The Elements of the Heliograph, by Frederick K. Ward, Signal Office. The Special Characteristics of Tornadoes, by John P. Finley, Signal Office. Weather Proverbs, 1883, by H. H. C. Dunwoody, Government Printing Office. The Correspondence University Announcement for 1884, January. Abstract of Account of Archæological Excursions in Ohio and Wisconsin, by F. W. Putnam. Catalogue of Officers and Students of Yale College, 1883–4. Second Annual Catalogue of Hamilton College, 1883–4, Rev. Henry Darling, D. D., LL.D., President. The Birth and Growth of Myth, by Edward Clodd, F. R. A. S.; price 15c, *Humboldt Library*. New Carboniferous Fossils, Bulletin No. 2, by Wm. F. E. Gurley, February, 1884. *Of Work and Wealth*, by R. R. Bowker, Publisher, 4 Morton St., New York. Observations of the Comets, 1880-1-2, Prof. Ormond Stone, A. M., and Herbert C. Wilson, Cincinnati, Ohio, 1883. Kansas, with Information concerning Agriculture, Horticulture, and Live Stock, Wm. Sims, Sec'y, Topeka, Kansas. Suggestions on Library Architecure, American and Foreign, J. L. Smithmeyer, Washington, D. C. Bulletin of School of Classical Studies at Athens, by Wm. N. Goodwin, Boston, Mass.

SCIENTIFIC MISCELLANY.

A VISIT TO THE AFFLICTED CATTLE REGION OF KANSAS.

S. B. BELL, M. D.

[We received this article too late to use the whole, but give the results of Dr. Bell's observations, the conclusion being that he found no evidences of the existence of the dreaded "foot and mouth disease," but believes that the greater part, if not all, of the trouble has arisen from freezing and lack of food and water.]—ED. REVIEW.

Upon entering the herds the first impression was the general thin, bony, gaunt, skeleton, shadowy, dried-up, wrinkled, condition of the cattle. * * * * * * * * * After a general survey of the situation I spent half a day searching for epizootic aphtha. I thought I would pick out a bad case and test it thoroughly by inoculating twenty animals. I inoculated four only. I looked in vain for an eye or mouth symptom. Not a tear, not a sign of mouth trouble, no swollen tongue, no salivation, not a slobber, not a sore. No lesion of mouth, lip, tongue, roof, or palate. Some had had blistered gums, but the blisters were perfectly healed, with only a mere trace of discoloration of the gums. There was not an ulcer, pustule, pock or pimple that I could find in the herds. There were no chancres, with deep hardened base as represented in the printed cuts.

Their mouths were abnormally white, owing perhaps to their rigidly enforced dietetic regulations. There were abundant lesions of cold horns, trimmed ears as if by a pair of scissors. There were hollow tails and dead tails, dropped tails, and dropping tails. Their bellies are hollow as that of a hungry wolf—their horns as whistles and their bones as clear of marrow as a bird's. They are almost bloodless—the organisms that should have gallons of rich blood have only pints of impoverished blood. There will be a shower of tails and hoofs on the Neosho this spring, and perhaps all through the high prairies of the west. But the great, sad, sorrowful lesion is of feet and toes: one hundred and thirty-two cattle of all kinds in three herds, Keith's, Hindman's and Trebinow's, affected in the feet and legs. Whenever affected at all, the part so affected is entirely dead and dried up and separated by sloughing the dead part from the living unless the bones and tendons hold them together—which is the case remote from joints. The separation is as perfect in all as if a surgeon had commenced an amputation by the circular method—cut down clean to the bone and then left his patient without sawing off the bone. At the ankle joints the amputation is complete without the aid of surgery. There is little swelling and the stumps and raw surfaces

are granulating and healing—healthy sores, as the doctors say; that is, there appears to be no tendency to spread and extend up the involved legs—no erysipelas or blood-poisoning. There are twelve to eighteen bad cases, the balance are all convalescent, and with good care and feeding, will soon be fit for beef, (or bologna sausage).

One hundred and twenty-nine are affected in the hind feet. When the fore feet are affected the hind feet of the same animal are much more affected.

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RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

IRON PAVING-BRICK.—A paving-brick or block consisting of a cast-iron shell filled with concrete and having yielding surfaces or strips interposed between the iron shell and the concrete filling, has been patented by Mr. J. M. Glenn, of Cincinnati, Ohio.

CORN-HARVESTER, ETC.—In the usual method of cutting corn or cane, the stalks are grasped by one hand and a heavy corn-knife is wielded with the other, but Mr. G. E. Alinder, of Athol, Dakota, now comes forward with a very simple and novel apparatus for use in this work, inasmuch as the knife is attached to the boot or shoe of the operator.

PROCESS OF FIRE-PROOFING AND PRESERVING WOOD.—According to a method recently patented by Mr. W. W. Robinson, of Ripon, Wis., the material to be treated is subjected to a bath in a boiling solution of salt, quick-lime, sulphate of iron, mineral paint and sulphur, subsequently the wood is dried, then coated with a hot solution composed of mineral paint, whiting, glue and quick-lime mixed with linseed oil.

SAFETY-VAULT FOR BANKS.—This is a very heavy and presumably quite secure chamber for valuables. It is constructed of hard cast-iron blocks, each say one foot square, and firmly dovetailed together; strong vertical rods assist to bind the different courses of blocks into a substantial solid mass. The door slides in a steel-lined recess and the lock- and bolt-work is located in a correspondingly lined recess in the opposite side of the door-way. The door consists of a single block of hard cast-iron having imbedded therein a perforated wrought-iron case. In case over-security should be demanded, the entire outer and inner surface of the vault may be provided with a lining of steel. The inventor is Mr. John T. Hough, of Chicago, Ill.

PATCHING FIRE-HOSE.—Mr. G. W. Towle, of San Rafael, Cal., has patented a patch for bursted fire-hose and it consists of a segmental plate of metal conforming to the size of the hose to be patched, and adapted to be placed over

the rupture and locked in place by means of clamping-bands also of metal. Under a heavy pressure, and if at a fire of any considerable dimension and danger, the hose are liable to burst and necessitate the stream to be stopped until the ruptured section can be removed from the line and a new one substituted therefor. This may allow the fire to gain such destructive headway that it cannot be controlled before an unlimited amount of property and possibly human life has been destroyed while on the other hand, by the simple application of a patch to the ruptured hose, which operation requires but a few seconds, and to the detriment of the fire, this delay would be avoided.

APPARATUS FOR PRODUCING AND BURNING GAS.—A steam boiler is provided with a suitable super-heating attachment, from which a supply of steam is drawn as required by the process, which consists in addition to the above described boiler, of two or more coal-coking or gas-producing furnaces, together with the requisite valves and connections between the boiler, furnaces and holder. In the operation, gas is produced suitable for cooking, heating and other purposes, by passing air through ignited gas-producing coal in such a manner as to produce perfect combustion at the lower stratum of the glowing mass, thus forming comparatively pure carbonic acid, then converting the acid so formed into carbonic oxide, and at the same time, distilling off the heavy hydro-carbons by passing the carbonic acid up through the mass of coal, after which super-heated steam is introduced into the gaseous products, and finally passing the products down through a bed of incandescent carbon, by which latter operation the previously introduced steam is decomposed and forms an additional volume of fixed carbonic-oxide and hydrogen. Recently patented by Mr. L. D. York, of Portsmouth, Ohio.

EDITORIAL NOTES.

THIS is the closing number of the seventh volume of the REVIEW. We have no space for comment, but refer any reader who doubts its utility as a popular science magazine to the index which accompanies this issue. We shall hope for a large increase of subscribers with the beginning of the next volume. Please read the prospectus on fourth page of cover.

WE were much gratified by a day's visit from Prof. E. D. Cope, the eminent palæontologist and co-editor of the *American Naturalist*, on the 28th ult. He was on his way to the City of Mexico and stopped over for the night train. On his return in the latter part of the month he will, if possible, deliver an address before our Academy of Science in compliance with an urgent invitation.

THE U. S. Signal Service is engaged in a careful and extended investigation concerning the history, origin and development of tornadoes, and asks the co-operation of observers, librarians, newspaper editors, etc., in obtaining facts of all kinds bearing upon the subject. All such items should be addressed to Sergeant John P. Finley, Signal Corps U. S. A., Washington, D. C., who will promptly furnish instructions, blank forms, etc.

D. H. TALBOT, a well-known scientist of Sioux City, Iowa, has prepared a memorial or open letter to Congress, urging the propriety and importance of establishing in the National Park, a grand Zoological Garden, where the various species of wild animals of at least the north-west can be collected and their habits studied under far more favorable circumstances than anywhere else. It is a valuable suggestion, and the naturalists of the country should aid in carrying it into effect.

MR. F. A. SAMPSON, one of the contributors of the REVIEW, delivered an interesting address at Sedalia on the 12th of February, in advocacy of the establishment of a Natural History Society there. Missouri presents a wonderful field for naturalists and such societies; wherever organized, can find an abundance of material to work upon and can be of the greatest service to science in general, and at the same time assist in the developem nt of the resources of the State.

JUDGE F. G. ADAMS, Secretary of the Kansas State Historical Society, has learned that in 1856 an Englishman, named Buckeridge, published some views of this city and points in Kansas, and is very anxious to ascertain whether or not any of our older citizens possess any of them.

ON the 4th ultimo the Kansas City Medical College held its 15th annual commencement. Addresses were delivered by Judge S. O. Thacher, of Lawrence, Kansas, Professor J. H. Van Eman, M. D., and Professor T. B. Lester, M. D., and diplomas granted to fifteen young gentlemen. On the 13th inst. the Medical Department of the University of Kansas City, held its third annual commencement. Addresses were delivered by the President of the Board of Regents, Rev. N. Scarritt, D. D., and by Professor J. M. Allen, M. D. The degree of Doctor of Medicine was conferred upon thirteen young gentlemen. On the 14th inst. the Hospital Medical College held its second annual commencement. Addresses were delivered by Hon. R. T. VanHorn, Prof. J. Thorne, M. D., Mrs. Emma J. Kimmell, and Rev. J. H. Savage; the latter upon "Reform and Progress in the Colleges." Diplomas were granted to nine members of the graduating class.

THE tornado season has commenced, and, what is a little singular so far, the localities affected have been principally east of the Mississippi River.

THE late Prof. J. Lawrence Smith's private collection of meteorites, the largest in the world, has been bought by Harvard College for $10,000.

DR STEPHEN BOWERS, who is now a resident of San Buenaventura, California, authorizes us to say that the article we copied from the Santa Barbara *Independent* is utterly false, so far as it relates to Indian skulls having been found with false teeth and the finding of mortars and pestles of agate. Dr. Bowers has visited the collection said to have contained these finds, and pronounces it a fabrication for which the reporter of the above named paper alone is responsible. No such things have ever been found among the Santa Barbara stock of Indians.

The arrival at Kansas City on the 27th ult. of the first through train from the City of Mexico, was an occasion of much rejoicing, as this road adds another grand feeder to our commerce. The trade of New and Old Mexico has always been a source of profit to this city, in fact was the origin of it in the days when it was merely a landing for steamboats discharging their cargoes of freight for the distant points in those States. The immensity of this trade in the future is incalculable.

THE whole northern half of the western addition to the University of Missouri, is to be used as a scientific museum. Prof. G. C. Broadhead, former State Geologist of Missouri, has recently spent several months in overhauling and arranging the immense quantity of specimens on hand there, some

of which have been packed away in cellars and out-buildings for the past twenty years.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *Central Baptist* of St. Louis, Mo, is among our exchanges. It is the leading Baptist paper west of the Mississippi River. It has an able editorial corps, with contributors and correspondents in all parts of the world. It is firm in its devotion to Baptist principles, yet kind and courteous in its discussions. It is brimful of news, religious and secular, and has special Departments for Family, Farm, Science, Education, Literature, Sunday-schools, Missions, Markets, etc., etc. It publishes the sermons of Spurgeon and other great preachers. Price, $2.00 per year. To ministers, $1.50. Specimen copies free.

THE *Atlantic Monthly*, for April, opens with the second chapter of Mr. Craddock's story, "Drifting Down Lost Creek." There follows a paper on presidential nominations, by Oliver T. Morton. The interesting serial stories, "A Roman Singer," "En Province," "In War Time," are each continued. N. S. Shaler contributes an original and highly suggestive theory upon the red sunsets. George Parsons Lathrop has a poem entitled, "Night in New York." The above gives only a portion of the varied table of contents that is offered in the present number.

THE January issue of *Van Nostrand's Engineering Magazine* was the first number of the thirtieth volume. It is, as we have often said, the best periodical for practical and skilled engineers published in this country, and as such deserves their generous support. That it has not received it, however, is quite evident from the following remarks by the publisher: "The continuance of its publication will depend, therefore, very much upon its support for the present year. If our educated engineers can afford to permit its discontinuance from lack of adequate support, the publisher certainly can afford to do so, to his advantage." It is to be hoped that so valuable a magazine will not be allowed to fail for want of support, when there are so many engineers in the country who not only can readily afford to take it, but who also actually need such an one for the sake of keeping up with the progress of the scientific and technical work in their profession.

THE REVIEW OF SCIENCE AND INDUSTRY at Kansas City is about to begin a new volume under favorable auspices. This journal now ranks next to the *Popular Science Monthy* in this country, which it very much resembles in size and form. The REVIEW is ably edited, has a wide contributing patronage from American scientists and is a credit to the West.—*Chicago Saturday Evening Herald.*

PROF. W. P. TROWBRIDGE, of the School of Mines, Columbia College, contributes to *Harper's Monthly* for April a very important and timely paper on Modern Sanitary Engineering, full of valuable suggestions relating to the water-supply of large cities, the sewerage of large inland and coast towns, the subsoil drainage of cities, house-drainage, and ventilation.

THE *North American Review* for April, has, among its other papers, a discussion by N. Dingley, Jr., M. C., and John Codman, as to the decline of American shipping. Rev. Dr. Phillip Schaff writes upon the development of religious freedom. Julian Hawthorne takes up the subject of literature for children. Rev. Drs. Mortimer and Heber Newton discourse upon recent critcisms of the Bible.

THE *Medical Index*, is the title of a new journal just started in this city. It is handsome in appearance and solid in contents. It is edited by Drs. J B. Browning, F. F. Dickman, and N. A. Drake, and managed financially by Drs. J. W. Elston and A. P. Campbell. Forty pages; monthly: $2.00 per annum.

SOME bold and ingenious (amateur) engineer proposes over the instials of C. L. O., in the St. Louis *Republican* of February 27th, to prevent floods in the Lower Mississippi by diverting the water of streams above into channels: For instance to "tap the Missouri River at Kansas City and by a channel convey it through to the Neosho River at a point near Ft. Scott, a distance of about seventy miles, and then e through that stream to the Arkansas River, about one hundred miles. The water could be so regulated that it would make the Neosho and Arkansas navigable without permitting them to overflow and not interfere with navigation on the Lower Missouri and Mississippi."

To this scheme Professor G. C. Broadhead replies in the same paper of March 1st: "The gentleman probably has not visited Kansas City, nor has he travelled across the country for one hundred and twenty-five miles southwest to the Neosho River at Neosho Falls, nor down that stream to its junction with the Arkansas. Probably he may imagine it would be easy for the Missouri to leap three hundred and fifty feet above the valley at Kansas City to reach the summit, twenty-five miles southwest, and should also remember that, although the Neosho River lies in a broad valley, yet we find that the surface of Kansas gradually rises westward and railroad elevations and Gannett's tables inform us that nowhere in the State of Kansas does the valley of the Neosho descend as low as the elevation of Kansas City above the sea. At the State line the Kansas valley is seven hundred and sixty-three feet above the sea; at Neosho Falls the valley of the Neosho River is one thousand feet, at Parsons nine hundred and twenty feet and the crossing of St. Louis and San Francisco in the Indian Territory about seven hundred and fifty feet above the sea."

PROFESSOR M. W. HARRINGTON, Director of the Observatory of Michigan University, announces the publication of the *American Meteorological Journal* about May 1, 1884. It will be a monthly of 32 pages, octavo, published by Dr. W. H. Burr, of Detroit, at $3.00 per annum. Contributions are solicited from meteorologists everywhere.

THE *Art Interchange* of March 2th contains two colored studies by Miss Caroline Townsend—one suitable for decorating a hand-bag, and the other for stenciling or embroidery. A beautiful design for ceiling decoration also appears in that issue, also a study of a toad, designs for a set of fruit d'Oyleys, several designs for small articles in brass repousse work, designs of thistle for cup and saucer decoration, and a panel design of hummingbirds.

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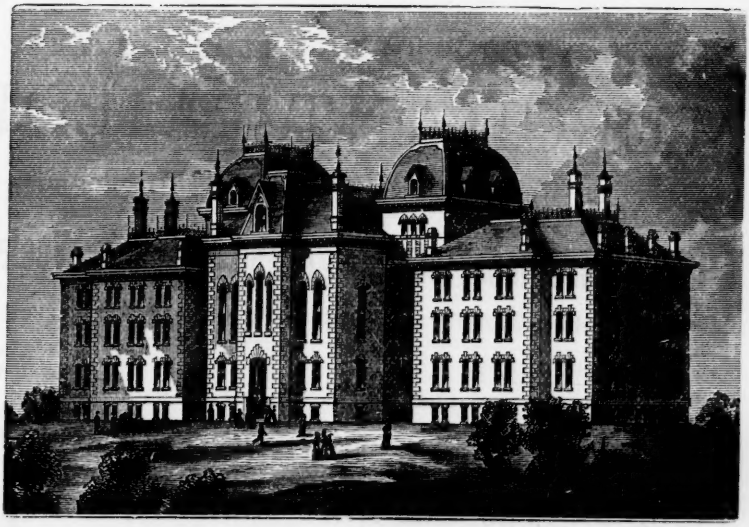

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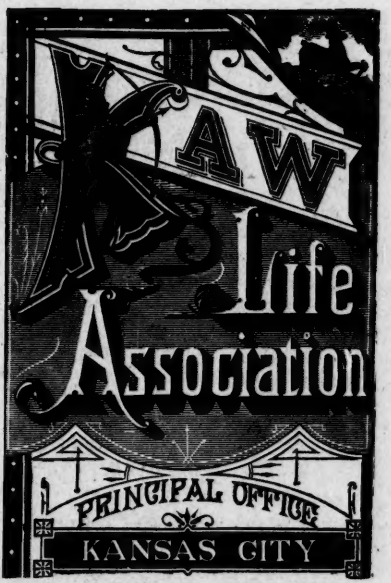

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